

# HELMINTHIC INFESTATIONS OF MAN IN 'IRAQ.

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Helminthic infestation or "Helminthiasis" denotes a state of infestation with one or more parasites of the zoological phyla Platyhelminia, Nemathelminia, or Annelida.

In 'Iraq these infestations are very common, both in man and the lower animals, and, in this thesis, I propose to give a résumé of my knowledge of the subject in so far as it affects man.

The observations contained in this thesis are based on personal experience gained as a physician of the Iraq Health Service, and I have chosen this subject for consideration, because, both from a medical and an economic point of view, I consider its occurrence, treatment, and prophylaxis to be among 'Iraq's most pressing problems; the subject, too, is a new one.

The three phyla concerned in helminthic infestations are included in an artificial group of metazoal, non-vertebrate, bilaterally symmetrical, and limbless animals, the "Helminthes", or "Worms", and, apart from entomological types, the group includes all the multi-

cellular animals parasitic in man.

Helminths do not represent a systematic group of animals, but they nevertheless represent a biological one. Of the three phyla comprising the group, the phylum ANNELIDA, which contains the parasitic HIRUDINEA, or LEECHES, is of little importance in the scope of

## HELMINTHIC INFESTATIONS OF MAN IN 'IRAQ.

### SECTION I.

#### INTRODUCTION.

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cellular animals parasitic in man. In this way "optimum"

Helminths do not represent a systematic group of animals, but they nevertheless represent a biological one. Of the three phyla comprising the group, the phylum ANNELIDA, which contains the parasitic HIRUDINEA, or LEECHES, is of little importance in the scope of this thesis, as infestations by members of this group do not appear to occur in 'Iraq; on the other hand, both PLATYHELMIA and NEMATHELMIA are of paramount importance, as each phylum contains a number of parasitic helminths which cause infestations in man in this country.

Each of the three phyla contains both free living and parasitic forms which are closely related; in fact, it seems probable that the parasitic forms are derived from free living forms, which, in the process of time, have become highly specialised for a parasitic existence.

Within the group of "HELMINTHES" two main forms of parasitism exist, namely PERIODICAL (Occasional), and PERMANENT (Stationary), depending on whether the parasitic stage alternates with a free living stage, or whether the whole life cycle of the parasite is passed in the same animal. The phylum ANNELIDA affords many examples of periodical parasitism, while all the helminths belonging to the PLATYHELMIA and NEMATHELMIA known in 'Iraq afford examples of permanent parasitism.

Each parasitic species has become adapted to life only in certain animals, or "hosts", and, furthermore, in only certain organs, or tissues, or "habitats", of that host, though, occasionally, one meets with species

helminthic infestation among her population. The in abnormal hosts or habitats. In this way "optimum" hosts or habitats have become recognised for each parasite.

most of the helminthic parasites of man use him as an occasional host, some lower animal being the optimum host; complete dissociation of human or medical helminthology from animal helminthology is therefore impossible, but in this thesis, as already noted, only those infestations which I have found to occur in man in 'Iraq will be considered.

The nomenclature of helminths is still very confused, but a code of nomenclature is gradually being accepted by zoologists whereby the original Latin designation, both generic and specific, of any animal is considered the valid one. This "Law of Priority" has caused a certain amount of confusion during the transition stage of its adoption, but ultimately uniformity will be attained, in place of the discord which has so often existed previously regarding the rival claims of a name, or of one or more of its synonyms, to validity.

As regards hosts, I need hardly mention that the host harbouring the larval stage of the parasite is called the "INTERMEDIATE HOST", and that the host harbouring the larval adult forms is known as the "FINAL" or "DEFINITE HOST".

In all some 30,000 helminths have been described, but medical helminthology only recognises about 70 of them, and, of these, some 30 only are of known pathological importance. 'Iraq can boast of 14 varieties of

helminthic infestation among her population. The resumé contained in my thesis is based on investigations I have made since 1919, first when resident at Hillah, and, later, as Physician to the New General Hospital, Baghdad, and Visiting Physician to the Meir Elias Hospital, Baghdad. I hope, too, in my thesis to reveal the importance of this subject both from a medical and an economic point of view.

Two of the infestations, namely ankylostomiasis and schistosomiasis, outweigh the others from both points of view.

Brief reference only will be made to signs, symptoms, pathology, and treatment, except in so far as unusual features have been met with; it has, too, not been thought desirable to insert a description of the anatomy of the parasites concerned, as this is readily obtainable in text books.

The thesis is illustrated by a number of aerial photographs, for which I am indebted to various members of the Royal Air Force stationed in 'Iraq; the smaller photographs have been taken by myself.

(d) To the West, the Syrian Desert.

(e) To the South-West, the desert of Northern Arabia.

The sketch map on the following page shows the boundaries of the country as detailed.

Until quite recently the name of 'Iraq was restricted to the alluvial plain between Baghdad and the Persian Gulf, an area identical with the land of Sumer, the ancient home of the Babylonians. The designation 'Mesopotamia' was, until the time of King



## SECTION II.

### THE BOUNDARIES AND PHYSICAL FEATURES OF 'IRAQ.

Before going further into my thesis, it is, I think, advisable for me to define the boundaries of 'Iraq, the inhabitants of which, since 1921, have been under the rule of His Majesty King Faisal.

The League of Nations' final decision regarding the northern frontier was only issued in December 1925, but this, however, represents the identical northern boundary of the area which is embraced in my thesis.

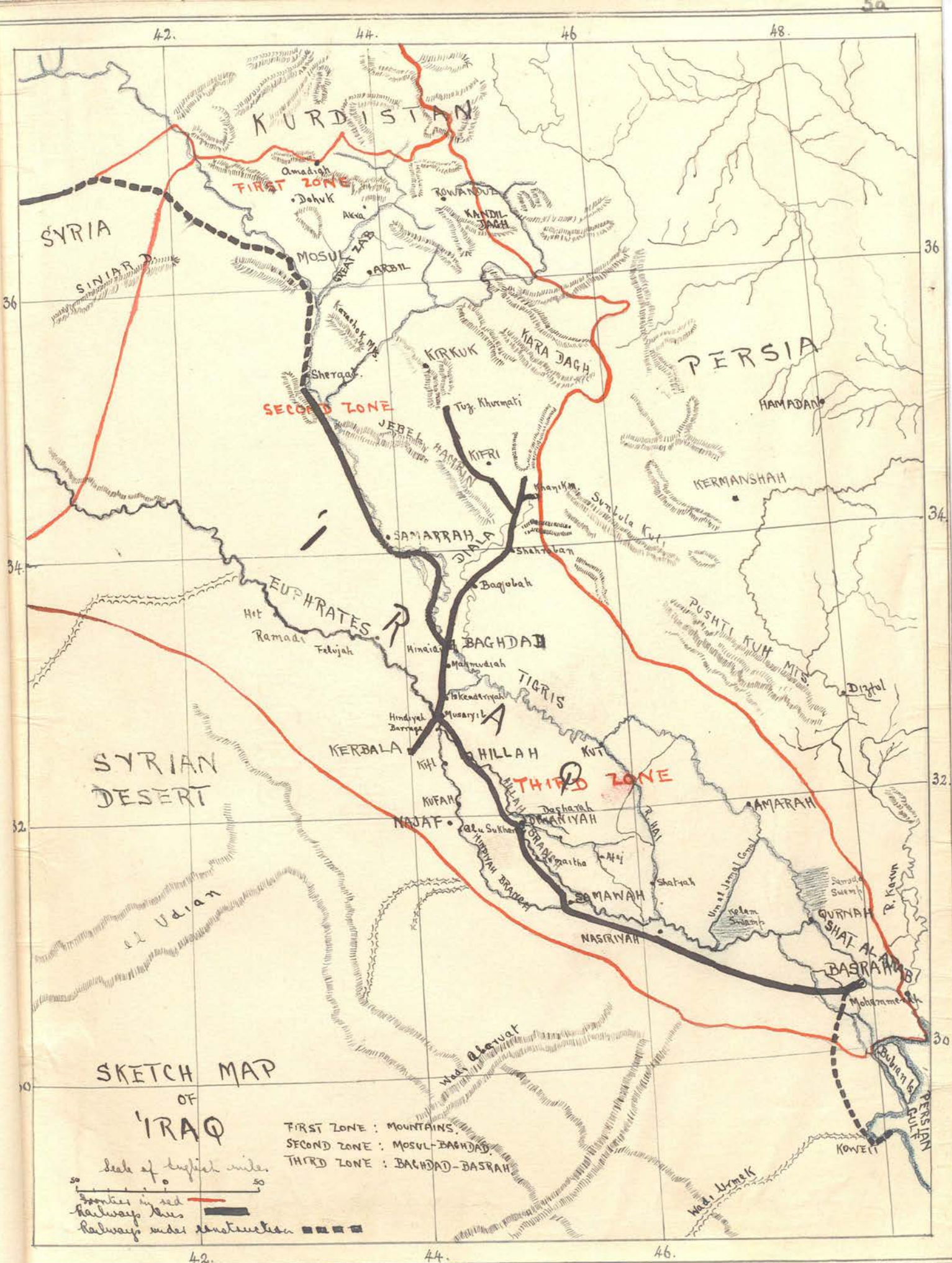
The following are the boundaries of the country:-

- (a) To the South, the Persian Gulf.
- (b) To the South-East, East, and North-East, the mountains marking the Persian Frontier.
- (c) To the North, the table lands of Asia Minor and Armenia.
- (d) To the West, the Syrian Desert.
- (e) To the South-West, the desert of Northern Arabia.

The sketch map on the following page shows the boundaries of the country as detailed.

Until quite recently, the name of 'Iraq was restricted to the alluvial plain between Baghdad and the Persian Gulf, an area identical with the land of Shinar, the ancient home of the Babylonians. The designation "Mesopotamia" was, until the time of King







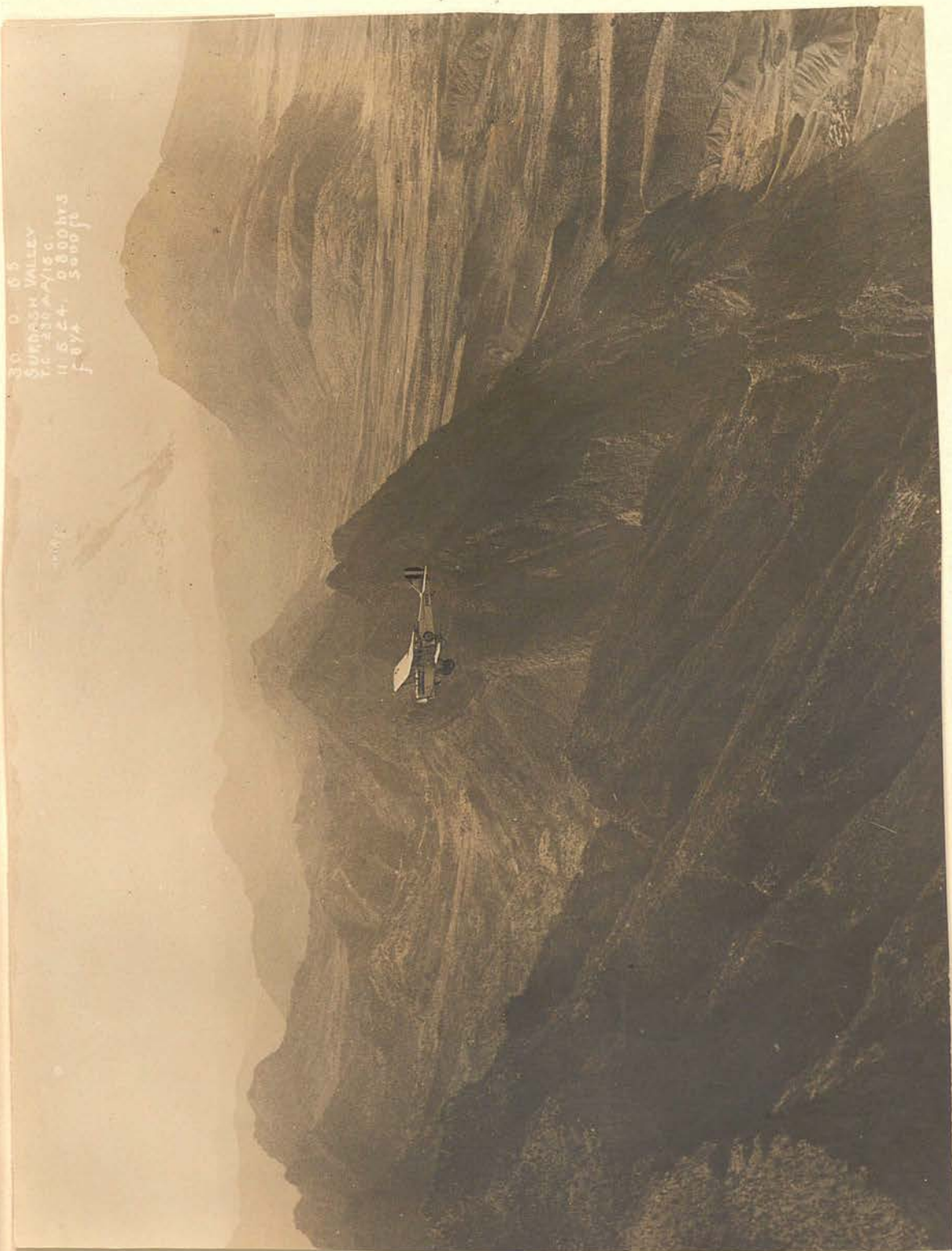
Faisal's accession in 1921, applied to the whole country now called 'Iraq, and, excluding the mountainous boundaries to the North-East and South-East, "Mesopotamia" consisted of two portions, namely, an upper area known as Jezireh (island), and a lower area known as 'Iraq (plain), or Al 'Iraq Arabi (the Arab plain). The name "Mesopotamia" is of obvious Greek origin, the Arabic equivalent being "Bain en Naharain" ("between the two rivers").

The name "Mesopotamia" is now no longer employed officially, and the name 'Iraq may be considered to include the same areas as previously constituted "Mesopotamia".

By its physical characteristics, 'Iraq readily falls into three zones, a zone of mountains, a zone of rolling plain, and a zone of flat plain.

By far the greater portion of 'Iraq is composed of the second and third zones, but the mountain zone deserves mention at least, from the fact that it is from the snow clad mountains to the North-East and South-East of 'Iraq that the main water supply of the two large rivers, the Euphrates and the Tigris, and their tributaries, is obtained; the mountain regions have a very sparse population, and in many regions are quite uninhabitable.

The second zone, roughly corresponding to the late "Jezireh", a rolling plain, comes next in ascending importance from the point of view of this thesis. It is a very sparsely populated region, and possesses a relatively cool climate. In this region there is a big



SURDASH VALLEY.

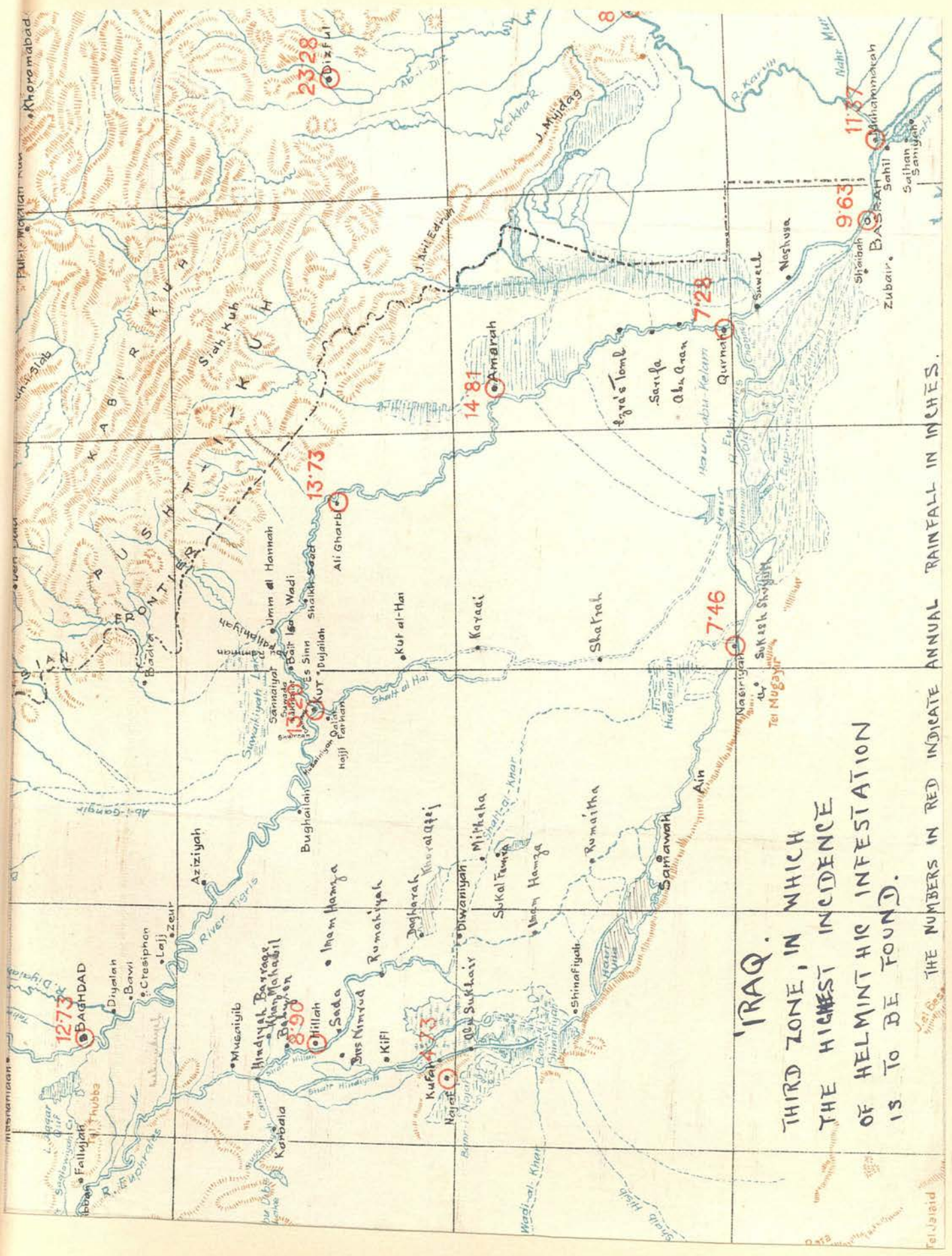
Mountain Zone.  
Northern frontier of 'Iraq.

declination from North to South for the rivers on their course to the sea. Mosul, 550 miles from the Persian gulf, stands 980 feet above sea level. This big difference results in the river currents in this part of their courses being very rapid, and the river banks steep, and free from much weed growth. Below Baghdad, in the third zone, this big declination ceases. Baghdad, 200 miles south of Mosul, stands 105 feet above sea level, and Basrah, 300 miles south of Baghdad, stands only 5 feet above the level of the sea. It is easy to appreciate from these figures how much slower must be the river currents south of Baghdad as compared with the country to the north.

The second zone, like the mountain zone, has a fair rain-fall, and the elaborate irrigation systems, such as are found in lower 'Iraq, are not required for cultivation. The importance of these facts of physical geography just mentioned will be considered later when discussing local factors in the spread of helminthiasis; meanwhile, it suffices to emphasize that they are important and definite factors in helminthic spread in 'Iraq.

The third zone, the area of dead plain, 300 miles long, and 70 miles broad, is by far the most important one from the point of view of the study of helminthiasis; in fact, it might almost be called "the helminthic zone", as the two most serious helminthic infections occurring in man in 'Iraq, ankylostomiasis and schistosomiasis, are practically restricted in distribution to these areas. The causes of this will be considered





IRAQ.  
THIRD ZONE, IN WHICH  
THE HIGHEST INCIDENCE  
OF HELMINTHIC INFESTATION  
IS TO BE FOUND.

THE NUMBERS IN RED INDICATE ANNUAL RAINFALL IN INCHES.



both flora and fauna are killed in the process of

in more detail later in this thesis, but, in passing, one might note the higher temperature of this zone, the larger population, the slow running rivers, and the extensive irrigation demanded by an almost total absence of rain-fall.

While considering geographical features, it is perhaps not out of place to note that in the earlier history of 'Iraq, in the days of Babylonia and Assyria, the physical conditions were very different from what they are now. Upper 'Iraq was more highly cultivated, and also more highly populated, while in Lower 'Iraq the sea was at Eridu, 125 miles north of Basrah; the present swamps of lower 'Iraq were non-existent, and the whole country was much better adapted for cultivation.

The third zone represents a perfect plain, consisting of a fertile alluvium with hardly a stone to be seen.

There are in parts huge depressions which are at all times swamps, and other depressions which only become swamps during the flood season of late spring; these dry up again during the summer months. The permanent swamps, during the warmer months of the year, produce a luxuriant growth of weed, and of fauna of the nature of snails which feed on the swamp vegetation. Certain snails are intermediate hosts of trematode worms, and, in relation to schistosomiasis, these swamps, when situated in the proximity of a community, are an important potential factor in helminthic spread. The temporary swamps being dry during the hot weather are not factors of much importance in this connection, as





A typical river scene near Diwaniyah. Here the banks are low and flooding of the countryside occurs in the spring of each year.



A typical group of fellaheen. The group consists of beaters at a shoot in the middle Euphrates area of which the author was a member.

great from the Indus to the Euphrates in 326-325 B.C., left record showing that at that date the Tigris and the Euphrates entered the Persian Gulf independently.

The Euphrates has no constant tributary after passing the zone of mountains, but the Tigris perennially receives water from a number of tributaries which are derived from the heavy rainfall of the Persian mountains, and it contributes the larger share of the water forming the Shatt-al-Arab.

The flood waters of both rivers contain much sediment, as much as 750 parts per 100,000, whereas the river Nile has little more than a fifth of this amount when in flood. During the flood season large tracks of the third zone are inundated, and this accounts for the great fertility of the area.

The soil contains ample plant food, nitrogen, potash, and phosphorus, but, in certain areas, the percentage of sodium chloride is very high; to this high percentage of sodium chloride I attribute lack of vegetation in certain areas, and the curious local distribution of snails. These are important points and will be considered later when discussing the subject of schistosomiasis.

There are some 60,000 Jews, who mostly reside in Baghdad, and over 150,000 Armenian and Syrian Christians in about equal numbers. The latter are to be found in and about Mosul and Baghdad.

The Jews and Christians are almost without exception urban, while the Mohammedan population is divisible into four classes, which numerically are equal:

(1) nomads, who own flocks and herds, but have no

land or settled habitation. The nomads live in tents, and their lives are spent in moving from place to place with their cattle.

- (2) Semi-nomads, who have fixed abodes and cultivate land, but spend a large part of the year moving about with their flocks in order to find

### SECTION III.

#### THE POPULATION AND INHABITANTS OF 'IRAQ.

(3) Settled cultivators, who are allied to the no very reliable census has ever been taken, but semi-nomads, but differ from them in that they an estimate of 'Iraq's population as 2,500,000 persons is probably not very wide of the truth. Over three-

(4) Town dwellers.  
fifths of these inhabitants occupy the alluvial plain region. Of these four classes the settled cultivators are the area of 'Iraq may be taken as approximately the most infested with helminths, and the nomads least 180,000 square miles, giving  $13\frac{1}{2}$  inhabitants to the square mile. This is a very sparse population, though it factors in helminthic spread are discussed. must not be forgotten that certain parts are uninhabitable, in the south, mainly owing to lack of irrigation, in the north, owing to the presence of mountain ranges.

Of the  $2\frac{1}{2}$  million souls,  $2\frac{1}{4}$  millions are Mohammedans, sunni and Shiah sects being equally divided. The former sect predominates in the north, and the latter in the south.

There are some 60,000 Jews, who mostly reside in or about Baghdad, and over 100,000 Armenian and Syrian Christians in about equal numbers. The latter are mostly to be found in and about Mosul and Baghdad.

The Jews and Christians are almost without exception urban, while the Mohammedan population is divisible into four classes, which, numerically, are equal:

- (1) Nomads, who own flocks and herds, but have no



land or settled habitation. The nomads live in tents, and their lives are spent in moving from place to place with their cattle.

- (2) Semi-nomads, who have fixed abodes and cultivate land, but spend a large part of the year moving about with their flocks in order to find pasture land for their animals.

- (3) Settled cultivators, who are allied to the semi-nomads, but differ from them in that they never move away from their habitation.

- (4) Town dwellers.

Of these four classes, the settled cultivators are lying in sub-tropical latitudes. Briefly the climatic the most infested with helminths, and the nomads least peculiarities of the country, and more particularly of of all; the reason for this will be obvious later when the area from Baghdad to the Persian Gulf, are as factors in helminthic spread are discussed.

follows :-

- (1) A large annual, and large daily range of temperature, but a high mean annual air temperature.
- (2) A small vapour content in the atmosphere, though south of Larnah this feature becomes less characteristic.
- (3) Little rain-fall.

These conditions, and, however, referable to the most easterly districts, result in considerable evaporation, and in the third zone evaporation far exceeds the rainfall, which amounts to not more than 6 inches annually. It is not difficult to appreciate that under such conditions, were it not for the two rivers, the country would be nothing but desert, and even with

#### SECTION IV.

#### THE CLIMATE OF 'IRAQ.

'Iraq has a "continental, sub-tropical, climate", or, in other words, it has the general characteristics possessed by areas which lie at a distance from an ocean, in addition to those features common to a country lying in sub-tropical latitudes. Briefly, the climatic peculiarities of the country, and more particularly of the area from Baghdad to the Persian Gulf, are as follows :-

- (1) A large annual, and large daily range of temperature, but a high mean annual air temperature.
- (2) A small vapour content in the atmosphere, though south of Qurnah this feature becomes less characteristic.
- (3) Little rain-fall.

These conditions, not, however, referable to the most northerly districts, result in considerable evaporation, and in the third zone evaporation far exceeds the rainfall, which amounts to not more than 6 inches annually. It is not difficult to appreciate that under such conditions, were it not for the two rivers, the country would be nothing but desert, and even with



TABLE I.

AVERAGES AND EXTREMES

AT BAGHDAD, LAT. 33°21'N, LONG. 44°26'E.

MONTH.	TEMPERATURE. °F.							Amount of Rainfall.
	Mean	Mean Daily Extremes.		Mean Monthly Extremes.		Absolute Extremes.		
		Max.	Min.	Max.	Min.	Max.	Min.	
January	48.9	59.0	38.8	67.7	29.3	79.9	20.8	1.18"
February	53.8	64.7	42.8	73.6	34.2	84.8	27.7	1.09"
March	63.0	76.3	49.6	83.7	40.0	98.8	33.5	1.24"
April	70.8	83.3	58.2	92.7	50.1	107.7	43.8	0.90"
May	86.0	93.8	68.1	103.8	58.1	112.6	46.5	0.26"
June	90.4	104.2	75.9	112.3	69.0	119.2	62.8	0.02"
July	94.6	109.5	79.7	116.0	73.1	122.8	69.6	0.00"
August	94.4	109.8	79.0	116.7	72.3	121.0	68.9	0.16"
September	89.7	103.5	75.8	112.0	63.4	117.2	56.0	0.07"
October	78.7	92.4	63.9	101.8	54.1	108.0	47.5	0.08"
November	62.8	75.1	50.6	86.0	40.2	95.3	29.5	0.93"
December	54.2	63.4	45.0	71.5	33.0	81.0	18.6	1.27"
YEAR ..	73.9	86.3	60.6	94.8	51.4	122.8	18.6	7.20"

TABLE II.

AVERAGES AND EXTREMES AT BASRAH, LAT. 30°25'N, LONG. 47°50'E.

T E M P E R A T U R E. ° F.									Amount of Rainfall.
MONTH.	Mean	Mean Daily Extremes.		Mean Monthly Extremes.		Absolute Extremes.			
		Max.	Min.	Max.	Min.	Max.	Min.		
January	52.6	61.0	44.3	69.5	35.0	80.1	23.7	1.39"	
February	57.0	65.6	48.4	74.4	38.4	87.3	31.1	1.21"	
March	65.0	74.6	55.5	83.8	46.5	93.2	39.1	1.02"	
April	74.9	85.3	64.6	94.9	57.5	108.7	51.0	0.47"	
May	84.8	95.4	74.2	103.7	65.5	118.9	59.0	0.36"	
June	90.7	101.7	79.8	108.6	74.8	123.6	68.8	0.00"	
July	93.8	105.7	82.0	111.3	76.1	128.9	65.7	0.00"	
August	93.3	106.5	80.2	112.3	75.2	126.0	68.1	0.00"	
September	88.7	102.9	74.5	108.6	66.6	121.8	45.4	0.08"	
October	78.9	92.4	65.5	99.8	58.7	106.3	48.6	0.04"	
November	66.7	77.1	56.4	87.8	47.1	102.9	35.7	0.81"	
December	52.9	64.5	47.3	74.0	38.5	80.5	26.6	1.22"	
YEAR..	74.9	86.0	64.4	94.0	56.6	128.9	23.7	6.60"	

TABLE III.

AVERAGES AND EXTREMES AT MOSUL, LAT. 36°22'N, LONG. 43°14'E.

MONTH.	TEMPERATURE. °F.						Amount of Rainfall.	
	Mean	Mean Daily Extremes.		Mean Monthly Extremes.		Absolute Extremes.		
		Max.	Min.	Max.	Min.			
January	42.6	51.0	34.3	59.4	24.9	63.9	0.4	3.12"
February	45.6	54.6	36.7	61.0	25.8	67.1	4.0	2.65"
March	53.7	65.1	42.3	74.8	35.3	83.7	29.1	2.45"
April	62.4	74.2	50.6	82.2	43.2	91.8	36.3	2.50"
May	73.4	87.6	59.2	93.9	50.9	106.6	39.7	0.53"
June	83.8	99.6	68.1	105.4	59.4	111.8	56.3	0.02"
July	91.0	107.2	74.9	111.6	65.6	118.8	55.7	0.03"
August	90.1	106.6	73.7	111.7	61.2	117.7	59.2	0.00"
September	82.4	99.6	65.3	103.6	60.4	113.9	52.2	0.01"
October	72.1	87.4	56.9	94.0	51.9	99.0	46.2	0.40"
November	60.8	76.4	45.2	77.7	38.6	86.5	29.1	1.84"
December	46.9	56.6	37.3	61.9	30.6	71.8	24.3	2.32"
YEAR ..	67.0	80.5	53.7	86.3	46.0	118.8	0.4	15.87"

Diurnal Variation of Temperature.

The average range of temperature in a single day

Daily Range of Temperature, °

Degrees.

TABLE IV.

## Diurnal Variation of Temperature.

The average range of temperature in a single day for Baghdad is here shown.

Daily Range of Temperature, °F.		
Month.		Degrees.
January	..	21
February	.. 15.3	22
March	..	23
April	..	25
May	..	26
June.	..	29
July.	..	30
August.	..	31
September	..	31
October	..	29
November	..	25
December	..	21
Year	..	26

TABLE V.

present irrigation, it is but a relatively small area that is cul Average Annual rainfall totals parallel to the river of the three largest towns, anything up to a mile in width, in which crops, vegetables, and trees,

Place	Total inches.
Baghdad ..	7.20
Basrah ..	6.60
Mosul ..	15.87

such as date palms, willows, and poplars, flourish, the country in general, for the most of the year, presents a picture of desert, sparsely covered with camel-thorn and wild caper. In the spring, when a little rainfall occurs, grass springs up, and crops abound in depressions where the rainwater accumulates. In the

submontane tracts to the north, the rainfall is much

These averages show the marked predominance of rainfall in the second zone of 'Iraq as compared with the zone of rolling plain which extends from Baghdad to Basrah.

reference to the tables on the preceding pages emphasises the main characteristics of the climate.



present irrigation, it is but a relatively small area that is cultivated. Apart from a small area parallel to the rivers or their canals, of say anything up to a mile in width, in which crops, vegetables, and trees, such as date palms, willows, and poplars, flourish, the country in general, for ~~the~~ most of the year, presents a picture of desert, sparsely covered with camel-thorn and wild caper. In the spring months, when a little rainfall occurs, grass springs up, and crops abound in depressions where the rainwater accumulates. In the submontane tracts to the north, the rainfall is much greater, and the general conditions just mentioned are favourably modified accordingly; more vegetation as a result is to be seen.

Reference to the tables on the preceding pages emphasises the main characteristics of the climate.

## 2. NEMATHELMIA.

It is, however, only the parasitic forms that fall within the scope of this thesis.

Taking the three classes, Trematoda, Cestoda, and Nematoda, in order, in the course of my investigations I have met with the following varieties of parasitic helminths in man in Iraq:-

### A. TREMATODA.

1. *Fasciola hepatica*.
2. *Clonorchis sinensis*.
3. *Schistosoma haematobium*.



B. CESTODA.

4. *Hymenolepis nana.*
5. *Taenia saginata.*
6. *Taenia solium.*
7. *Taenia echinococcus.*
8. *Dipylid* SECTION V.

C. NEMATODA.

## GENERAL CLASSIFICATION OF THE PARASITIC HELMINTHS

9. *Ascaris lumbricoides.*
- OF MAN IN 'IRAQ.
10. *Ankylostoma duodenale.*

As already noted, the helminths which infest man in 'Iraq belong to one or other of the phyla Platyhelminia or Nemethelmia.

The zoological classes, into which these worms are readily subdivided, are as follows:

- |                                   |                       |
|-----------------------------------|-----------------------|
| considered separately later.      | 1. FREE-LIVING FORMS. |
| I propose briefly to discuss      | 2. PARASITIC FORMS:   |
| observed to control the spread of | (a) Trematoda.        |
| 'Iraq.                            | (b) Cestoda.          |
|                                   | 1. FREE-LIVING FORMS. |
| 2. NEMATHELMIA.                   | 2. PARASITIC FORMS:   |
|                                   | (a) Nematoda.         |

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5. *Taenia saginata.*
6. *Taenia solium.*
7. *Taenia echinococcus.*
8. *Dipylidium caninum.*

C. NEMATODA.

9. *Ascaris lumbricoides.*
10. *Ankylostoma duodenale.*
11. *Necator americanus.*
12. *Enterobius vermicularis.*
13. *Strongyloides stercoralis.*
14. *Trichuris trichiura.*

Infestation with each of these worms will be considered separately later, and, in the next section, I propose briefly to discuss the factors which I have observed to control the spread of helminthiasis in 'Iraq.

It is well known that, introduced when 'Iraq was subject to Turkish rule, are "hamams" (Turkish baths), and slowly, the population is learning principles of cleanliness, though a bath, or even an extensive wash which combines soap, is a luxury in which the majority, even of the better educated town dwellers do not indulge more often than a very few times annually.

In response to Koranic dictates, Mohammedans usually rinse their hands before and after meals, and before their prayers, but it is only the well-to-do and more educated classes that include soap in their ablutions.

The Jews as a whole are not so cleanly. The incidence of infestations with nematode helminths, as I shall show later, is very high in 'Iraq, and there would undoubtedly be a higher incidence were ablution, however sketchily performed, not a part of the religion of the vast majority.

## SECTION VI.

Uncleanliness in defecation is almost universal.

### 1. FACTORS CONTROLLING THE SPREAD OF HELMINTHIC

#### INFESTATION IN 'IRAQ.

Toilet paper is not used, but, usually with the modes of dissemination of helminths in 'Iraq are two in number, namely, animal agency, and contamination. These methods of spread are controlled by certain factors, as follows:

#### 1. GENERAL SANITARY MEASURES.

##### (a) PERSONAL HYGIENE.

The personal hygiene of the 'Iraqi is certainly no worse than that of other eastern races, and it is possibly a little better than most of them.

In all the large towns, introduced when 'Iraq was subject to Turkish rule, are "hamams" (Turkish baths), and, slowly, the population is learning principles of cleanliness, though a bath, or even an extensive wash which combines soap, is a luxury in which the majority, even of the better educated town dwellers, do not indulge more often than a very few times annually.

In response to Koranic dictates, Mohammedans usually rinse their hands before and after meals, and before their prayers, but it is only the wealthier and more educated classes that include soap in their ablutions.

The Jews as a whole are not so cleanly. The incidence of infestations with nematode helminths, as I shall show later, is very high in 'Iraq, and there would undoubtedly be a higher incidence were ablution, however sketchily performed, not a part of the religion of the vast majority. Uncleanliness in defaecation is almost universal among the native population of 'Iraq. Toilet paper is not used, but, usually with the uncovered hand, following defaecation, the parts are rinsed with water. 'Iraq should be grateful that infestation with *Taenia solium* is a rarity; carriers of this parasite would be very liable to auto-infestation with *cysticerci* at such a time through oncospheres being conveyed on the fingers from faeces to mouth; pig is, however, forbidden in the dietary of the vast majority, and so infestation with *Taenia solium* maintains a very low incidence.

The wearing of boots and shoes is, as yet, only common among town dwellers, and in 'Iraq, persons drawing water from the rivers, or working in gardens barefooted, lay themselves open to infestation with *Schistosoma haematobium*, *Ankylostoma duodenale*, and *Strongyloides stercoralis*.

(b) PREPARATION OF FOOD. The natives eat both cooked and un-cooked dishes. Of the cooked food there is one particular delicacy which is usually but half-cooked, and I consider it a big factor in Taeniasis (*Taenia saginata*) in 'Iraq.

I speak of the "kabab".



There are several varieties of kabab, varying from a form of rissole to portions of meat stuck on skewers, and held over a charcoal flame for a few moments while continuous fanning of the whole is practised. When prepared in this way, the meat is rarely fully cooked. Fruit, lettuces, cucumbers, tomatoes, and radishes, are most commonly eaten in a raw state, and unwashed, or washed in any dirty puddle or canal; uncooked vegetables and salads are a further big factor in the spread of nematode helminthiasis, and probably the biggest one as regards the European population of the country.

The fields and gardens of 'Iraq are much contaminated with human faeces, for to pass excreta near water is an observance ordained in the Koran. The European is usually more careful about both his water supply and his personal hygiene, but he displays much less care in the preparation of his food. The salads and fruits of European residents are seldom very carefully washed or sterilised before being eaten.

I have no doubt that by far the majority of cases of ascariasis among Europeans result in this way. The European is to some extent dependent on his servants in these matters, but supervision is surprisingly lax in the average European household in 'Iraq. Even after vegetables have been washed, and a weak permanganate of potash solution is very suitable for the purpose, there remains the risk of contamination with helminthic ova from the handling of vegetables, or even of the dishes in which they are served, by dirty native servants.

degree in excess of his immediate requirements.



Cleanliness of servants is a point on which education, even in European households, is much needed in 'Iraq. In out-stations, especially, where officers are usually without their wives to supervise such things, I have known cases of vegetables being washed by servants in water undoubtedly contaminated, and eaten by officers who boasted of the hygienic excellence of their household arrangements. By far the safest procedure of all, though somewhat Utopian, is to eschew all uncooked vegetables. a smaller fish still, called "bunni".

#### (c) CHARACTER OF FOOD. ~~for Mohammedans or Jews,~~

and of There is little doubt that insufficient and improper food predispose to helminthic diseases, and this is most especially true in regard to ankylostomiasis. a very The 'Iraqi town-dweller maintains a much more liberal diet than the bedouin or tribesman, who lives mainly on milk, cheese, butter, bread, fruit, (particularly dates), rice, and vegetables. Meat to the bedouin is quite a luxury, and two or three times a week is probably a fair indication of his indulgence in this relatively expensive commodity. The sparseness of meat in the dietary is to be accounted for from financial reasons; the bedouin is improvident, and lives from day to day. There is nothing to induce him to be thrifty, and to save money; he knows that if he does so he will probably have the money speedily stolen from him; he may even lose his life on account of it, and, as long as he has food and drink daily of some sort or the other, he rests content, and toils not the least degree in excess of his immediate requirements.

Fish is a fairly popular article of diet, but it is relatively scarce in 'Iraq, and the varieties are very few. The various fresh water fish, such as pike, perch, and grayling, in which the larval stage of *Dibothriocephalus latus* is passed, are not found, and hence infestation with this parasite does not occur.

The edible fishes of 'Iraq are limited to three varieties, "biz", often from 6 to 7 feet in length, and weighing over 100 lbs, "shabut", from 1 to 6 lbs in weight, and a smaller fish still, called "bunni".

Pork is not eaten by either Mohammedans or Jews, and of the pig family the wild boar only is found in 'Iraq.

The character of food is, however, not, in itself, a very important factor in helminthic spread in 'Iraq; it is in the handling and preparation of food, by contaminated hands, that great facilities exist for the spread of infestation.

Beef is eaten by all classes of the community, and the beef tapeworm, *Taenia saginata*, is the commonest tapeworm infestation which I have observed.

#### (d) DISPOSAL OF EXCRETA.

In the large towns of 'Iraq almost every house has a cess pit latrine, which incidently provides most of them with a very offensive odour. The 'Iraqis, like most eastern people, squat to defaecate. The cess pit latrines are emptied by special contractors, who carry the liquid excreta in skins on the backs of donkeys to the outside of the town, where it is spread, dried, and

buried - unless purchased or stolen for manure by enterprising vegetable growers. *Ascaris ova* are resistant to septic tank processes, and can remain alive in the excreta of these cess pits for several months.

The pits are cleaned out when they become full, annually, or a little oftener. Unless badly fouled, however, cess pit latrines are not directly an important factor in helminthic spread.

In the smaller towns and villages, defaecation and micturition are effected almost anywhere and everywhere by the Arab. He contaminates his premises, particularly his roof if it will support him, his garden, or the garden of a neighbour. The most popular places of all, however, are the river banks, or the edges of irrigation canals or small channels, where water is handy for toilet purposes, where vegetation gives some privacy, and Koranic dictates are readily fulfilled; such water supply is used for domestic purposes also!

Toilet paper as already noted, is not used following defaecation, and a smooth stone is usually employed at the end of micturition to remove any residual drop of urine. excreta is proportionately increasing.

On the river banks in the early morning in both towns and villages, there is usually an animated scene, for at that hour the male population is to be found congregating prior to exercising its excretory functions. The Arab women naturally perform these functions less publicly, usually in the neighbourhood of their abodes.

In the larger towns, and at the majority of the railway stations, public cess pit latrines have been introduced, constructed of cement, and emptied as occasion demands.

It is easy to see that garden produce may thus become infested with helminthic ova; an important factor in the spread of *Ascaris lumbricoides* and *Trichuris trichiura*, infestations which are very common through 'Iraq.

As observed previously, the two most important helminthic diseases of 'Iraq, both pathologically and economically, are ankylostomiasis and schistosomiasis. These infestations will both be considered at length later, but, given other conditions, such as warmth, no more ideal breeding ground for their larval parasites is possible, nor is there a site which possesses greater potentialities as a means of spread than the moist neighbourhood of the water's edge.

Europeans in 'Iraq rely on commodes, cresol, and sweepers for their disposal of excreta.

Indian sweepers, a product of the war, are gradually being replaced by local sweepers, and carelessness in disposal of excreta is proportionately increasing. The Mohammedan will rarely accept such duties, and the vast majority of sweepers obtainable are old and decrepit Jews. The almost universal conservancy system among Europeans in 'Iraq is a commode, in which half an inch or more of a weak solution of cresol is maintained. The commode is emptied as necessary, and incinerated at public incinerators maintained by the municipality in



suitable parts of the town.

On building the new British Residency, a flush conservancy system was introduced, and this has been followed by a similar system at the Royal Palace, and at the Headquarters of the 'Iraq Railways in Baghdad, but these are almost the only systems of this kind yet inaugurated in 'Iraq.

## 2. RELIGION.

As a factor in helminthic spread in 'Iraq, religion is of definite importance.

Mohammedans and Jews are both forbidden by their religions to eat pork, and hence *Taenia solium* infestations, as already noted, are rare in 'Iraq.

As noted under the heading "personal hygiene", ablution is a religious matter with Mohammedans; this, I think, probably accounts for the slightly lower incidence of ascariasis and trichuriasis which I have observed among Mohammedans as compared with Jews. On the other hand, however, it probably accounts in no small degree for the much greater incidence of ankylostomiasis and schistosomiasis among Mohammedans in the villages, where clean water is, but rarely, used for purposes of ablution.

The religious prejudices of Mohammedans, particularly of the Shiah sect, against the adoption of western methods, in either prophylaxis or medical treatment, is a further factor in the spread of helminthic disease. Shiahs comprise 50% of the Mohammedan population of 'Iraq, but they are mainly confined to the southern half of the country - but this, unfortunately, is the area



in which the incidence of helminthiasis is highest.

### 3. CLIMATE. summer when there is moderate heat,

As a factor in helminthic spread, the climate of 'Iraq is of paramount importance. Some helminths, such as *Ascaris lumbricoides*, will grow under almost any climatic conditions, whereas others, such as *Ankylostoma duodenale*, are very sensitive to climatic changes. Of climatic conditions affecting helminthiasis, temperature claims first place, and rainfall, though more indirectly, second place. With regard to temperature, it is, within big limits, true that the higher the temperature the more favourable are conditions for helminthic increase, and, without a warm climate, 'Iraq would speedily be freed of its two most important helminthic diseases.

In the north of 'Iraq climatic conditions are cooler, and, in winter, considerable cold is experienced; from Baghdad southwards, however, there is practically no cold weather.

The fact that helminthic diseases are much commoner in southern than in northern 'Iraq is in great measure dependent on the higher temperature in the southern half of the country.

As a factor in helminthic spread, there is another aspect of the effect of temperature to be considered, namely, that in the hottest months of the year evaporation is such that, except for land artificially irrigated, the country-side becomes almost barren desert; promiscuous defaecation and urination in the summer time under such conditions is not, therefore, of nearly as much danger as at other times of the year; the most favour-

able time for helminthic spread in 'Iraq is in the late spring and early summer, when there is moderate heat, a moist condition of the land, and abundant vegetation.

The presence of vegetation is of special importance in the spread of schistosomiasis, as without it larval snail hosts would die.

There is still a further aspect of the effect of temperature, namely, its existence in excess. 'Iraq's temperature in summer reaches over 120°F in the shade, and, apart from its powers of evaporation, this very high temperature has a direct effect on the ova of parasites found the world over, such as *Ascaris lumbricoides* and *Trichuris trichiura*. Excessive heat inhibits their growth, and exposure to the direct action of the sun's rays, especially during the summer months, destroys them.

The effect of rainfall on the spread of helminthiasis will be considered in the next paragraph.

#### 4. CONTROL OF WATER SUPPLY.

Streams are the natural sewers of the regions they drain, and, when used as a source of water supply, there is established a direct connection between the alimentary canals of the people living upstream with the mouths of those below. The settled population of 'Iraq is sparse, and only collected into very scattered communities on the river banks.

Pollution of river water with excreta, and so with helminthic ova, undoubtedly occurs, but infestation resulting in one town by water carriage from another community must be very rare; there is an enormous dilution of ova by the time the next community is



Control of Water Supply.

Automatic chlorinating apparatus in use in Baghdad. The water on being pumped to the storage tanks from the sedimentating tanks is automatically chlorinated by a concentrated solution of bleaching powder which flows from the small tanks on the right of the picture.

reached.

A much more serious state of affairs is the great facility on the river banks for the spread of schistosomiasis and ankylostomiasis, though the risk of infection with the latter disease in this way is much greater, as the snail intermediate hosts required by schistosomiasis to complete their life cycle are more commonly found in the smaller channels where the stream is more sluggish, and weeds much more abundant.

As previously noted, "dipping" is the usual method of collecting water for all purposes by the majority of the population, except in the larger towns, and no one in the villages troubles to take his water supply from a point above the town. The sites where buffaloes drink and wallow have usually a good approach to the river, and, on this account, are very commonly chosen for drawing drinking water.

Water is never drawn from the middle of a stream by the native population; such a procedure at the present stage of its education would be considered not only unnecessary, but even ludicrous, when it can be obtained by less effort from the river bank. The river's edge is the favourite native site for the performance of excretory functions. The river banks of both rivers, which are in most parts sloping in an easy gradient to the river, are readily accessible, and present no obstruction to walking.

The damp earth at the edge is peculiarly ideal for the growth of ankylostomes, and, as just noted, from



Control of Water Supply.

Two sedimentation tanks, one filled and one empty, in the Railway Cantonment, Baghdad. The pump-house is seen in the background.





Control of Water Supply.

A storage tank, near Baghdad West station, erected by the Germans before the Great War and still in use.



Control of Water Supply.

Storage tanks in Baghdad.

These tanks are of British pattern, and after sedimentation and chlorination of the river water, the water is pumped into tanks such as these for household purposes.

this area most drinking water in the smaller towns and villages is obtained. Ankylostome larvae are capable of infesting man in two ways, by being swallowed, and by penetrating the unclad feet and legs of a person collecting water from a contaminated site, and, in 'Iraq, the river banks display an amount of faecal accumulation which is almost incredible. Except for the three largest towns, Baghdad, Basrah, and Mosul, for all practical purposes, control of water supply may be considered to be non-existent.

In these three towns drinking water is pumped from the river, and then sedimented and chlorinated before distribution through the town in pipes. It must not, however, be thought that the whole population in these towns has a safe supply of drinking water, for even in them, not more than half the houses have water pipes. The remaining 50 percent of the population of these towns draw their water direct from the river banks, as is customary in the smaller towns and villages.

'Iraq is dependent on its two rivers for its water supply, and for its very existence. Gardens and fields must be watered, and 'Iraq is situated in an almost rainless subtropical zone where as little as 2 inches of rainfall for a whole year has been recorded, and 3 or 4 inches is as much as is commonly received.

In order to overcome the scarcity of rainfall, which is limited almost entirely to the rainy season from November to April, with the maximum rainfall in December and January, the river supply has to be utilised for cultivation purposes.





The left bank of the Diala river, much contaminated with human faeces.



Except for the rainy season, when the country-side has a very verdant appearance, and crops can be cultivated away from river supply, 'Iraq's cultivation is restricted to a narrow belt of vegetation a mile or so in width on each bank of the rivers and their tributaries. Large artificial canals have been constructed in places linking up the two rivers, and this seems to be the solution of 'Iraq's main irrigation problem, but it is the small irrigation canals, either off-sets from the larger ones, or even direct from the river, which are of paramount importance in the spread of the two most serious varieties of helminthiasis met with in 'Iraq.

As I shall emphasise later in this thesis, the northern parts of 'Iraq are less heavily infested with schistosomiasis than the southern areas, and this fact, apart from temperature considerations already considered, depends mainly on the irrigation of the country.

Irrigation is readily divisible into two varieties, "lift" and "flow". The term "lift irrigation" signifies that the water in the river is well below the height of the river banks, and that some mechanical device is required to obtain water for purposes of cultivation.

Petrol driven motor pumps are becoming increasingly common, but still by far the greatest amount of lift irrigation is accomplished by artificial elevators known locally as "ghirds".

A photograph of a typical ghird appears on the following page. It consists of a huge goat skin bag which is raised by an ox from the water to a water channel situated at the top of a short incline; a sup-



IRRIGATION IN 'IRAQ.

The photograph depicts a double ghird on the bank of the Hillah branch of the Euphrates.

porting rope passes over a wooden roller supported on tree stumps, and the bag fills and empties itself automatically. The rotation of the roller produces a curious loud noise which penetrates the surrounding quietude of garden and palm grove. Each ghird has its own characteristic note, and it is not unusual to find the arab in charge of it singing to its melody. Almost invariably, a ghird is to be found under the shade of a massive mulberry tree, the shadiest tree that 'Iraq possesses.

Ghirds are found throughout the whole length of 'Iraq, but are less common as one journeys southwards, but there, also, "lift" irrigation is to be found. North of Baghdad, particularly in the region of upper Euphrates, the water wheel is common, but it requires a very powerful stream to work it, and so it is not invariably applicable.

There is another fairly common artificial elevator in use, namely the "dolab", or chain pump; an ox, occasionally, but more usually a donkey, is employed to work the chain and its buckets; the animal's eyes need to be completely covered while it is working in order to minimise the effect of constant movement in a circle.

By the term "flow irrigation" is meant water directly available for purposes of irrigation without the employment of artificial devices. Flow irrigation is more common in southern than in northern 'Iraq, and, in order to prevent flooding, the river banks have to be built up and constantly repaired.

Unless the ghird or pump is constantly being worked

the irrigation systems dry up during the warmer months, while with flow irrigation this is not so liable to occur. This fact has an important bearing on the spread of helminthiasis, and more especially of schistosomiasis, in 'Iraq. Snail intermediate hosts are killed by drying; lift irrigation, being the more difficult process of irrigation, affords greater possibility of its irrigation channels becoming dry, and hence more chance of the snails present in the channels being killed by dessication. I have no doubt that this accounts in no small measure for the greater incidence of the disease on the Euphrates as compared with the Tigris, and also for the greater incidence met with as one goes southward.

The photograph on the following page, taken from the air, shows a typical garden, and affords a good idea of the method of ultimate irrigation, a method traceable as far back as the days of Nebuchadnezzar. The land is divided by low embankments into small areas, and laid under water by alternate opening and closing of the trenches which run inside the embankments. The trenches are soon over-run with weeds, and the fellah only clears these away when they impede the flow of water. The result is an ideal breeding ground for fresh water snails, and these abound in most irrigation trenches during the warmer months of the year.

Weeds are rare in the rivers and big tributaries, though I, myself, have obtained specimens of *Bullinus contortus* and other snails from weeds on the left bank of the river Diala, but never, however, from the two





A typical irrigation system of lower Iraq showing large water channels and their ultimate divisions in the gardens of the neighbourhood.

main rivers. With these ideal breeding places for snails the spread of schistosomiasis in 'Iraq is easy; the presence of water near his work prompts the fellahen to perform natural functions in these trenches, which are further tempting by the screen of vegetation which the gardens provide.

Snail hosts of Schistosomes will be considered in some detail later, but, in passing, I would emphasise that snail hosts of only one variety of Schistosome have been found in 'Iraq to date. I have never met with a case of infestation with *Schistosoma mansoni* in the country.

During the war certain snails found in 'Iraq were wrongly considered to be species of *Planorbis*, and from the believed existence of these species of snail, and the known existence of *Schistosoma haematobium*, an erroneous conclusion regarding the existence of *Schistosoma mansoni* was arrived at.

#### 8. EMIGRATION AND IMMIGRATION.

The 'Iraqi travels little; in fact, even now, though railway and greater river facilities exist, I doubt if more than half the population of the large towns have been far beyond the outskirts; it is quite a small percentage of residents of Baghdad that have visited Basrah, and vice versa.

Emigration is not a factor which concerns 'Iraq primarily, but the importance of immigration cannot be overestimated.

The "holy cities" of 'Iraq, and especially Najaf and Kerbala, attract Shiah pilgrims from many different,





A typical date-grove of 'Iraq showing an irrigation channel leading from the river bank.

and even distant countries, so that the possibility of the introduction of new helminths into the country is ever present.

Sunni pilgrims do not visit 'Iraq, preferring the "Haj", or annual pilgrimage to Mecca and Medina, to visiting the few Sunni shrines in 'Iraq.

These pilgrimages, in addition to their menace to 'Iraq, are a menace to the health of the countries to which the pilgrims return, as it is very easy for infestation with helminths to occur under the bad sanitary conditions which prevail at the "holy cities".

In addition to Kerbala and Najaf, where great mosques exist, to Hussain and Ali respectively, there are two other important Shiah shrines, namely, at Khazimain, a few miles north of Baghdad, and at Samarra, further north, on the Tigris; the two latter places have mosques built over the remains of two of the twelve recognised "Imams" of the Shiah sect.

Shiah pilgrims arrive in 'Iraq at any time in the year, but certain anniversaries, and especially the anniversary of the battle of Kerbala, in which Hussain was slain, on the 10th day of Muharrem, in the year 580 A.D., are specially favoured for pilgrimage.

The pilgrims come mainly from Persia, Turkey in Asia, and India; from the two former countries they travel across the northern and eastern frontiers, and, from the latter, they reach 'Iraq by sea, and travel up country by railway or steamer. In this way almost every part of 'Iraq is constantly exposed to the possibility



of new helminthic infestations, an important consideration when the annual number of pilgrims reaches as many as 100,000 persons. The frequent aggregations of pilgrims at the holy places, and the unsanitary conditions which prevail there, constitute a constant helminthic and epidemic menace to 'Iraq, to the pilgrims themselves, and to the countries to which they return; this is an international problem, but ever confronts those of us who are working for the well-being of 'Iraq.

During the late war, from the year 1914 onwards, British military occupation brought large numbers of Indians and Egyptians into the country, and possibly the helminthic population has been thereby increased, though I only know of one case of a new infestation almost certainly brought into the country in this way, namely, a solitary case of infestation with *Clonorchis sinensis* which I have met with in 'Iraq.

## 6. EDUCATION.

Perhaps this heading would be better named "lack of education", for the negative aspect is more readily noted than is the positive one in 'Iraq. In the three large towns, good schools exist, but for the smaller communities educational facilities are sadly lacking, and it is rare to find a tribesman, be he sheikh or fellah, who can read or write.

The standard of intelligence is by no means low, but there is a spirit of fatalism, and an inborn desire on the part of the native to do no more labour than is an absolute necessity to keep body and soul together,

to somnolence in 'Iraq' at a meeting of the Baghdad Medical Society, at which nearly 30 local doctors were present. If trouble befalls the Arab, and helminthic trouble may well be included in the term, that it is the will of God disease existed in 'Iraq. It is not, therefore, only suffices for the peace of his own mind. Preventive measures in such an atmosphere are naturally fraught with difficulties, but, add to this a lack of facilities for learning the value of reforms of a sanitary nature, and one can appreciate why the Arab mind considers that such things may be all right for luxury-loving Europeans, but that they are a waste of both time and money in 'Iraq. In the large towns such association is limited, but 90 per cent of the population is several centuries behind our own civilization, and, under any circumstances, generations must elapse before education will have taught the tribesman to take a serious interest in sanitary measures. Infestation with *Taenia*

The value of anti-plague inoculation and vaccination against small pox he appreciates, but that river side defaecation or micturition is a sanitary sin, is absolutely beyond his belief; he even treats such a suggestion as an intense joke.

'Iraq is a poor country, and endeavours to improve education, and propaganda relating to the prevention of helminthic diseases, though of great urgency, are not likely to make any progress for years to come unless some such a body as the Rockefeller Commission can be persuaded to help us.

A large proportion of the local doctors even are quite ignorant of the occurrence of many of the helminthic infestations of the country.

On 21st March last, I read a paper on "Ankylos-

tosomiasis in 'Iraq', at a meeting of the Baghdad Medical Society, at which nearly 30 local doctors were present, and there were but two of them who knew that this disease existed in 'Iraq. It is not, therefore, only the laity that requires information on the subject of helminthic diseases; it is easy to criticise, but I think this shows how much spade work lies ahead for those of us who are working in 'Iraq as medical advisers to the government.

#### 7. ASSOCIATION OF INHABITANTS WITH DOMESTIC ANIMALS.

In the large towns such association is limited, but in the smaller towns, and particularly amongst the villagers and bedouins, man, cattle, dogs, and fowls, are all herded together in a manner which has to be seen to be appreciated. Infestation with *Taenia echinococcus* is rare, and it would appear to be but a kindly dispensation of providence that the incidence of this helminthic disease is not several times greater than it has been found to be.

Infestation of cattle from human faecal contamination of herbage must be common, and in this way *Taenia saginata*, for example, finds its larval host.

#### 8. INTERMEDIATE HOSTS.

Most parasites need a second host in order to complete their life cycles and these are termed "intermediate" or "larval" hosts. A good example of this in 'Iraq is afforded by the trematode, *Schistosoma haematobium*, which requires a snail host in order that it may complete its life cycle. Most intermediate hosts are specific, though occasionally parasites adapt themselves for life

in allied hosts. *Schistosoma haematobium* is believed by some authorities to be capable of living in another species of the genus *Bullinus*, in the absence of *Bullinus contortus*, but I have not been able to confirm this in my investigations in 'Iraq to date.

There is a curious local distribution of *Bullinus contortus* in 'Iraq which I attribute to the high percentage of sodium chloride which some areas possess, and in which this fresh water snail cannot thrive; this subject will, however, be considered again in a later section dealing with schistosomiasis.

#### 9. AGE AND SEX.

Age of itself is not an important factor in helminthic spread in 'Iraq, except in so far as it affects habits. Children are more careless in habits of cleanliness, and hence one would, I think, anticipate the higher incidence of helminthiasis which I have found to occur in them.

Schistosomiasis is a case in point. The optimum age in my experience is between 8 and 9 years, the age at which the creeks and canals prove most tempting for a bathe during the hotter months of the year.

Sex, too, is only a factor through the different mode of life that sex entails.

In 'Iraq, a purdah country, the confined life of women accounts, I think, for the lesser general incidence of helminthiasis which I have observed in them.

#### 10. DENSITY OF POPULATION.

Conditions of life and climate in Egypt are very similar to those of 'Iraq, yet the incidence of



helminthiasis is much higher in the former country.

This is, I think, readily explained by the denser population of Egypt facilitating helminthic spread. 'Iraq is undoubtedly saved from a higher incidence of helminthic disease by the scattered nature of its population.

#### 11. IMMUNITY.

Although I have no evidence to suggest the existence of any racial immunity against helminthic diseases of any kind, I have met with persons in whom immunity seemed to exist, and, hence, I have included this subject as a possible factor in helminthic spread.

In 1920, when I was Civil Surgeon in Hillah, I went into this subject very thoroughly, especially with regard to schistosomiasis. I found in every village persons physically similar, whose age, mode of life, food, and occupation, were all identical, and in whom exposure to infestation was constantly present. A very definite proportion of these were found free from schistosomiasis, a state of affairs that drew one to the conclusion that, though uncommon, natural immunity probably exists.

#### 12. VEGETATION.

Without water weeds, on which to feed the intermediate hosts, *Schistosoma haematobium* would die, and 'Iraq be freed from a very serious variety of helminthiasis.

Vegetation, in the guise of salads and uncooked vegetables, affords perhaps the commonest means of spread of ascariasis and trichuriasis in 'Iraq, but this has been considered previously under the heading "Disposal

of Excreta".

Herbage fouled by man is eaten by cattle, and the life cycle of 'Iraq's commonest human tapeworm infestation, *Taenia saginata*, is probably completed in this way.

The soil of 'Iraq is rich in plant foods, but vegetation is adversely affected by the presence of a high percentage of sodium chloride. A percentage of 2.5% of this salt in certain areas of 'Iraq is quite common, and is occasionally exceeded.

With regard to nourishment, parasites naturally differ according to the organ and tissue in which they choose to live, and, regarding the helminths found in man in 'Iraq, the following table shows the commonest situations where the parasites are found, and also the food they normally obtain.

Helminth.	Commonest site in man.	Food.
<u>TRICEMATODA.</u>		
1. <i>Fasciola hepatica</i>	Pharynx	Blood
2. <i>Clonorchis sinensis</i>	Bile ducts.	Bile
3. <i>Schistosoma haematobium</i>	Lower portal venous circulation.	Blood plasma
<u>CESTODA.</u>		
4. <i>Taenia solium</i>	Middle and lower third of small intestine.	Digested food.
5. <i>Taenia saginata</i>	- do -	- do -
6. <i>Taenia echinococcus</i>	(larval stage only in man)	Blood plasma.
7. <i>Dipylidium caninum</i>	Small intestine.	Digested food.

## SECTION VII.

### THE HELMINTHS OF 'IRAQ. THEIR FOOD, AND THEIR EFFECT UPON THEIR HOSTS.

With regard to nourishment, parasites naturally differ according to the organ and tissue in which they choose to live, and regarding the helminths found in man in 'Iraq, the following table shows the commonest situations where the parasites are found, and also the food they normally obtain.

Helminth.	Commonest site in man.	Food.
<u>TREMATODA.</u>		
1. Fasciola hepatica	Pharynx	Blood
2. Clonorchis Sinensis	Bile ducts.	Bile
3. Schistosoma haematobium	Lower portal venous cir- culation.	Blood plasma
<u>CESTODA.</u>		
4. Taenia solium	Middle and lower third of small intestine.	Digested food.
5. Taenia saginata	- do -	- do -
6. Taenia echinococcus	(Larval stage only in man)	Blood plasma.
7. Dipylidium caninum	Small intes- tine.	Digested food.





KHAN ISKENDERIYAH. (NEAR BAGHDAD).

Showing large irrigation canal of same name  
which supplies water from the Euphrates to the town.



Helminth	Commonest site in man.	Food
<u>NEMATODA.</u>		
8. <i>Ascaris lumbricoides</i>	Upper third of small intestine.	Semi-digested food
9. <i>Enterobius vermicularis</i>	Large intestine	Faecal material.
10. <i>Strongyloides stercoralis</i>	Upper third of small intestine	Mucosal cells and blood.
11. <i>Ankylostoma duodenale</i> .	- do -	- do -
12. <i>Necator americanus</i>	- do -	- do -
13. <i>Trichuris trichiura</i>	Caecum	Blood

It is only quite recently that the presence of toxic substances in helminthiasis has been demonstrated; possibilities, namely, mechanical, nutritive, and toxic. Previously much of the pathology was attributed vaguely to reflex action.

#### 1. MECHANICAL EFFECTS.

Where a mechanical effect of any gravity occurs, signs and symptoms are usually very evident; the following afford examples of the mechanical effects that one has observed produced by helminths in 'Iraq.

*Ascaris lumbricoides* in the small intestine producing acute intestinal obstruction, fibrosis of the bladder resulting from the passage of ova through the bladder wall in urinary schistosomiasis, and pruritus in infestation with *Enterobius vermicularis*.

#### 2. NUTRITIVE EFFECTS.

Nutritive effects depend on the number, size, species, and position, of the organism, though, as a general rule, these effects are not of a serious nature. Perhaps the best example of a nutritive effect in 'Iraq is given by ankylostomes, which, by living mainly on the blood of their hosts, tend to produce a serious

degree of anaemia. On the other hand, ascarides or tapeworms, living on residues of food, do not usually affect the host nutritively, unless present in large numbers, or the host is delicate or young, and so needs all the nourishment its system can obtain.

### 3. TOXIC EFFECTS.

The toxic effects most commonly noted in helminthic infestations are eosinophilia and anaemia. The former is a cellular response to infestation, the latter a humoral one. Nervous manifestations in ascaris infestations are most probably toxic in origin.

It is only quite recently that the presence of toxic substances in helminthiasis has been demonstrated; previously much of the pathology was attributed vaguely to reflex action.

Certain of these toxic substances (leucomaines) have been isolated by experiment, and their effects have been demonstrated; personally I have no doubt as to the existence of these bodies after my experience of helminthiasis in 'Iraq.

The symptoms of helminthiasis in 'Iraq are commonly of such a nature that the presence of the parasites cannot be definitely deduced, except by a process of exclusion. The microscopical examination of natural secretions and excretions, however, gives one a means of confirmation of diagnosis in very many cases.

parasitic to man in this country, these -

Family	Genus
(a) Fasciolidae	Fasciola.
(b) Opisthorchidae	Clonorchis
(c) Schistosomidae	Schistosoma.

## SECTION VIII.

### THE PLATYHELMINTHIC DISEASES OF MAN IN 'IRAQ.

#### A. TREMATODE INFESTATIONS.

As already noted, the Platyhelminia include both free living and parasitic forms. The former class is represented by the Turbellaria, or Eddy worms, the latter by two classes, Trematoda or Flukes, and Cestoda or Tapeworms.

Contained in the class Trematoda are three orders, Monogenea, Digenea, and Metastatica; the Digenea only, however, contain families parasitic in man in 'Iraq.

There is one family only of the order Digenea, belonging to the sub-order Prostomata, which is represented in the helminthic parasites of 'Iraq, namely, the Fascioloidea.

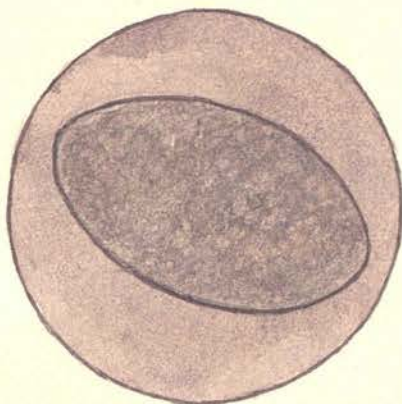
The (family) Fascioloidea is represented in 'Iraq by both hermaphrodite and unisexual forms. Belonging to the former, are the families Fasciolidae and Opisthorchidae, and to the latter the family Schistosomidae.

Each of these three families contains a genus parasitic to man in this country, thus -

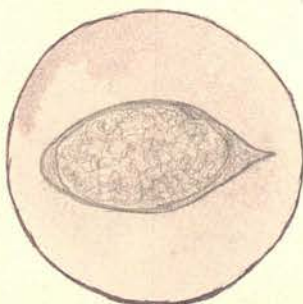
Family		Genus
(a) Fasciolidae	..	Fasciola.
(b) Opisthorchidae	..	Clonorchis
(c) Schistosomidae	..	Schistosoma.



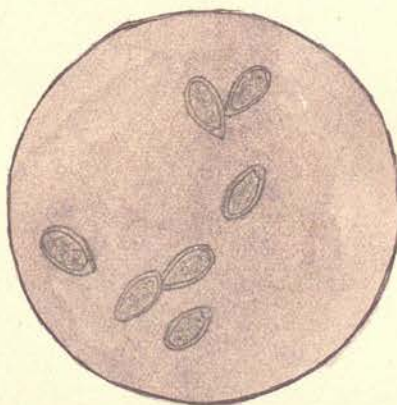
## TREMATODE OVA X 250



FASCIOLA HEPATICA.



SCHISTOSOMA HAEMATOBIIUM



CLONORCHIS SINENSIS



in north Lebanon, an infection known as "halzoun". Each of the three genera contains one species which is embraced by this thesis, namely -

Genus	Species
(a) Fasciola ..	Fasciola hepatica.
(b) Clonorchis ..	Clonorchis sinensis.
(c) Schistosoma ..	Schistosoma haematobium.

I now propose to consider in detail the main features presented by these infestations in 'Iraq.

#### 1. INFESTATION WITH FASCIOLA HEPATICA.

This helminth, commonly known as the "liver fluke", is frequently found in sheep in 'Iraq, causing the hepatic disease known as "sheep rot". In man, however, it is very rare, and I have only met with a solitary infestation with this parasite in the country.

The case that came under my observation, a fatal one, was brought to me in Hillah in November 1919.

The patient, Abbas ibn Mohammed, a fellah, aged 36 years, of the Albu Sultan tribe, was a resident of Imam Hamza, a village a few miles south of Hillah.

He arrived at the Civil Hospital, complaining of pain in the right chest, fever, and jaundice of 8 days duration.

On examination, the man's condition was very serious; the liver was enlarged and tender on palpation, and it extended to three finger's breadth below the right costal margin. Examination of the stools revealed the presence of a large number of the typical, large, operculated, yellowish-brown ova.

The patient returned home and died two days later.

In North Lebanon, an affection known as "Halzoun" exists, a pharyngeal infestation, but, in spite of the proximity of the Lebanon to 'Iraq, I have not met with the condition; presumably, because the 'Iraqi does not include raw sheep's liver in his dietary.

## 2. INFESTATION WITH CLONORCHIS SINENSIS.

I have only once found ova of this parasite in 'Iraq, and my patient was an Indian sweeper imported by the Railway authorities to the country only four months prior to him reporting sick with diarrhoea. The infestation was found quite accidentally when making routine stool examinations. The diarrhoea was quickly cured by simple measures, and after the administration of two doses of oil of chenopodium, given at an interval of 10 days, and in doses of 15 minims on each occasion, the man was cured and remained quite symptomless, until he returned to India after his year of contract service.

I have not met with a case of this infestation in an 'Iraqi, and I only know of two other cases being found in the country; during the war Acton found these ova twice in Indian patients who were members of Expeditionary Force "D".

Two intermediate hosts are needed by this helminth, the first a snail of the genus *Bythinia*, the second a fish of the carp family, but, as I have not met with either host in 'Iraq, I do not think there is much likelihood of clonorchiasis becoming endemic in the country.

### 13. INFESTATION WITH SCHISTOSOMA HAEMATOBIMUM.

This helminth, the cause of schistosomiasis as occurring in 'Iraq, shares with *Ankylostoma duodenale* the most important position in this country's helminthology, both from an economic and a pathological point of view, *schistosomiasis of the Far East*".

Three varieties of schistosomiasis are described, due to three distinct species of trematode of the genus *Schistosoma*, but, of these, only *Schistosoma haematobium* has been found in 'Iraq to date. The parasite is a bisexual trematode belonging to the family Schistosomidae. This family, apart from having the sexes distinct, is readily distinguished from others of the order Fascioloidea by the fact that the gut branches of Schistosomidae unite to form a single caecum; in the other families the gut branches end in separate caeca. (Schistosoma mansoni).

In spite of published statements to the contrary, for example, in Byam and Archibald's "Practice of Medicine in the Tropics", where it is stated that 'Iraq, infestation with *Schistosoma mansoni* "is not uncommon, in Mesopotamia", my own investigations point to the occurrence of only one of the three varieties of schistosomiasis, namely, Schistosomiasis (*Schistosoma haematobium*). The normal mode of entrance of the parasite to the human host is by penetration of the skin, and usually within 6 weeks, the adult form is reached. It requires from 6 weeks to 6 months from the date of infestation for symptoms to develop.

The disease manifestations of *Schistosoma haematobium* are usually described under the term "Urinary Schistosomiasis", while the other forms due to *Schistosoma mansoni* and *Schistosoma japonicum* are respectively known as "Intestinal Schistosomiasis" and "Schistosomiasis of the Far East".

With the terminology of the third variety, I have no present objection, but I feel that a modification of the other two forms is desirable, particularly since Dr. Mills and I have discovered that intestinal symptoms may occur in "urinary" cases.

I suggest that the terminology would be more scientific were it now changed to read "Schistosomiasis" with the name of the causal organism following in brackets, thus -

Schistosomiasis, (*Schistosoma haematobium*).

Schistosomiasis, (*Schistosoma mansoni*).

Schistosomiasis, (*Schistosoma japonicum*).

During the war, military and medical authorities in 'Iraq stated that *Schistosoma mansoni* occurs in 'Iraq, and also that its intermediate host, *Planorbis boissyi*, is common in the country. I am unable to accept either statement, which in each case I have traced to hasty, and inaccurate, conclusions. I think weight was given to the suggestion by the finding of numerous snails resembling *Planorbis boissyi*, and said to be this mollusc, whereas the identity should have been given as *Planorbis convexiusculus*, not known to be an intermediate host of *Schistosoma mansoni*.

The agents causing infestation in 'Iraq are the



in Mesopotamia, omitting all mention of its occurrence. larval forms or cercariae of *Schistosoma haematobium*, which enter the human body through the medium of infested water, either through the mucous surfaces, or directly through the skin, and, developing into adult forms, result in a chronic infestation. The infestation is characterised by the passage of terminally spined ova in the urine. It may lead to haematuria, inflammatory conditions, and neoplasms of the bladder and urinary passages, and, further, ova may be found in the faeces, and give rise to signs and symptoms of dysentery.

#### HISTORY.

The researches of the late Sir A. Ruffer have established the existence of schistosomiasis in Egypt as far back as the twentieth dynasty (1250-1200 B.C.), but the first note of its occurrence in 'Iraq dates back only to 1899, when Dr. Sturrock, of the Church Missionary Society in Baghdad, reported its prevalence. The disease, however, has, in all probability, had a very much longer reign in the country.

#### DISTRIBUTION IN 'IRAQ.

with regard to the geographical distribution of *Schistosoma haematobium* in 'Iraq, there is at present much confusion. Byam and Archibald state that "it occurs near Baghdad, and in villages on the Tigris", omitting all mention of the Euphrates, whereas the "Memoranda on Medical Diseases in the Tropical and Sub-Tropical War Areas", published by the War Office in 1919, notes that "it is said that bilharsiasis (urinary schistosomiasis) is known to exist at certain points along the Euphrates

in Mesopotamia", omitting all mention of its occurrence on the Tigris.

My own investigations, while on military service, and as a member of the 'Iraq Health Service, enable me to dogmatise very definitely in this connection, and as no definite account of the distribution has, I believe, previously been published, I propose to outline it at some length here. Figures illustrating the degree of incidence in various parts of the country will be considered later.

I have previously considered the geography of 'Iraq under three zones, namely, a zone of mountains, a zone of rolling plain, and a zone of flat plain.

The zone of mountains is, I am sure, absolutely free from schistosomiasis; during my 18 months as Physician to the New General Hospital, Baghdad, and two years as Visiting Physician to the Meir Elias Hospital, Baghdad, I have never seen a case from this zone, nor has a case ever been recorded by civil surgeons of the Health Service who have served there.

In the second zone, schistosomiasis has appeared quite suddenly at Arbil within the last three years, and this outbreak is of special interest as Arbil is a great coolie centre. Coolies from this district travel southwards to Baghdad and Basra in very large numbers in search of employment. Having saved a little money they return home to their families until want again makes them travel south. It is not difficult to appreciate, therefore, a probable origin of infestation. Although no specimens of likely snail hosts have so far

been found at Arbil, there must be a definite focus of disease spread there as some of the more recent cases have occurred in persons who have never left the area of the town.

A local infestation was reported too at Jihara, 8 miles from Kifri, by the Civil Surgeon of the Kirkuk division in June 1923. This hamlet consists of some 60 houses, and is situated on the eastern side of the Kingerban-Quaraghan section of the 'Iraq Railways. The first case discovered was the mullah (priest) of the village. He applied for treatment for haematuria and painful micturition at the Government Dispensary at Kifri, and it was then ascertained that five more adult males had complained of similar symptoms, and, on examination, ova of *Schistosoma haematobium* were found to be voided in the urines of all of them.

All the infested persons were insistent that there was no similar condition in the village 12 months previously, and confirmation of this was that at Tepa Serai, a village some 10 miles distant, formed but two years earlier, and consisting of people previously resident in Jihara, only one case of schistosomiasis was found on examination, namely, a boy aged 12 years.

No irrigation channels exist in the second zone, as rain is plentiful, and so breeding places for snails do not abound; the rivers, too, in this zone are fast running, a state which is very detrimental to luxuriant weed growth on which snails rely for nourishment.

Apart from Arbil and Jihara, the most northerly point on the Tigris from which I have received cases of

schistosomiasis is Shergat. I have personally had only one case of an infested Arbil resident, but, as this man was a coolie employed at the Hinaidi Cantonment, Baghdad, during the time of its construction, and the cantonment at that time was a known focus of infection, I am unable to blame Arbil for this particular infestation. However, in June 1923, the civil surgeon of Arbil reported some 10 cases who had applied for treatment at the civil hospital there. He further stated that there was no evidence of cases existing in Arbil 12 months previously, and he considered all his cases to be very recent and mild infestations. In February 1922 two cases of haematuria occurred among Indian soldiers of the 30th Lancers stationed at Shergat, and ova of *Schistosoma haematobium* were found to be present in the voided urine of both cases. The military medical authorities caused an examination of the urines of the 659 other troopers stationed there to be made, but ova were found in only one other case. There seem, therefore, good grounds for considering Shergat an infested community, even if only mildly so.

With regard to the Euphrates, I know of no cases having occurred north of Hit, and my records only give three cases of infestation occurring in that neighbourhood.

On the Diala river, a tributary of the Tigris, I have had 2 cases from Sharaban (population 1,500), and none north of that place. In 1918, Capt. Boulanger examined 20 persons from the Baqubah-Sharaban district, and found no infested case. With my Sharaban cases it







SHERGAT DISTRICT.  
Zone of rolling plain.

It was not possible for me to exclude possible infestation elsewhere, as both the positive cases had worked as agricultural labourers in other parts of the country. Several searches by me there, too, have not revealed the presence of *Bullinus contortus*, though the occurrence of this snail in 'Iraq is always very local; I can nevertheless definitely condemn the neighbouring town Baquabah (population 3000) in this respect. In January 1923, I found amongst other species of snail four undoubted specimens of *Bullinus contortus*; these were found in a garden on the left bank of the river below the bridge across which all travellers to and from the town must go, and, in the pilgrim season, there is a constant stream of Shiah pilgrims from Persia, as Baquabah lies on the direct route from the frontier to the holy cities of 'Iraq.

I had five positive findings in patients of all kinds from Baquabah. Both cases having "urinary symptoms" proved positive, and 3 also, out of 21 who were symptomless. All 5 of the patients were agricultural labourers working in one or other of the orange groves which lie to the left of the river. Baquabah is famed for its fruits, especially its oranges, and practically the whole population is agricultural.

By "urinary symptoms" I mean symptoms such as painful or frequent micturition, or haematuria, which point to a possible affection of the urinary system.

An incidence of almost 22% together with a finding of snail hosts in the area - I found no cercariae of any kind associated with these specimens, however, - is,



An irrigation channel overgrown with weeds in orange groves at Baqubah (Diala) in which numerous specimens of *Bullinus contortus* were found.



I think, strongly suggestive of a local focus of infestation, and this is confirmed by an outbreak in an Assyrian Refugee Camp which our Military authorities established at Baquabah during the latter part of the late war.

This camp was on the right bank of the Diala river, though some three miles distant from the town of Baquabah. The water supply of the Camp was obtained from the Diala River by canal. The camp came into being in 1918, and its occupants were refugee families from the mountainous neighbourhood of Lake Van, and, as far as one can gather, a region free from any suspicion of schistosomiasis.

In November 1918, three boys, aged between 8 and 10 years, reported sick with haematuria of a week's duration. These boys were friends, and occupied the same block, No. 32, of the mud buildings which had been constructed for the refugees. The refugees numbered, in all, some thousands, and they had the services of a fully equipped British military General Hospital in the area for their medical needs. It is, I think, of interest to note that the three cases were occupants of the same block, which suggests similar conditions of life and similar pursuits. These boys had all been bathing during the summer in irrigation creeks about the neighbourhood, and, presumably, they met the same focus of infestation. In January 1920, another boy, in a different block, No. 22, complained of haematuria. In February 1920, another case occurred in block No. 32, and in March 1920, nine cases occurred in boys living in block No. 18, situated next to block 22. Being near neighbours, the boys of blocks 18 and 22 went about a good deal together, and



frequented the same bathing spot. Contaminated drinking water is not, I think, nearly as important a means of spread as is bathing. All these cases were in boys from 8 - 15 years of age, and other cases followed.

Since the war, these refugees have scattered to different lands, and to different towns in 'Iraq, and a large number of them have formed a new suburb at Jilani, on the outskirts of Baghdad.

Starting from the places mentioned, in all of which the degree of infestation, as will be seen later, is a very low one, the incidence increases as one goes southwards, and it reaches its maximum in the third zone, the zone of flat plain.

In this third zone the climate is hotter, irrigation becomes "flow" in character, instead of "lift" as in the second zone, where the river banks are higher, marshes and ponds are common, and the rivers more sluggish in their flow. The warmer temperature, too, makes this zone the most favourable for the increase of molluscs, and the growth of larval trematodes.

"Flow" irrigation gives less chance of the dessication of irrigation channels, and, hence, less chance of the death of molluscs, or of weeds, by drying, and the presence of ponds, marshes, and sluggish rivers, means abundance of vegetation on which snails may feed. The area from Baghdad to Basrah, comprising the zone of flat plain, is the most important of the zones of 'Iraq as far as schistosomiasis, and, in fact, every existing variety of helminthic infestation, is concerned.

Conditions at Jihara are very favourable to snail

increase, and to the spread of schistosomiasis, as the only supply of water for either drinking or ablution purposes is a boggy stream, overgrown with weeds, a tributary of the Diala river.

Fortunately, no other population is served by the same stream, and the condition would soon be non-existent if control of the water supply could be effected. There is every reason to suspect that the outbreak at Jihara is attributable to infested coolies transported to the area on railway construction during the previous year.

Travelling southward from Shergat on the Tigris, I have had no cases of schistosomiasis from Baiji or Tekrit, but, from Samarra, I have had five cases, and, in this connection, it is interesting to note that Lt. Col. W. H. Lane, Commanding 1/94 Russell's Infantry found numerous shells of *Bullinus* at Samarra in 1918, and Captain Boulenger, in 1918, found two infested Arabs there among 20 examined.

In Baghdad itself, (population 200,000), a few cases have been recorded by the military authorities, though, of 25 cases, all presenting symptoms, which I have met with in civil residents, the majority had almost undoubtedly been infested outside. My Baghdad patients have all been 'Iraq Jews, infested on pilgrimage, at either Kifl, where the tomb of Ezekiel is situated (Nabi Heskail), or at Ezra's Tomb, south of Ctesiphon. Jewish pilgrimages are made annually to these places during the early summer.

The military cases occurred just south of the





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SAMARRAH. (TIGRIS)

One of 'Iraq's four Shiah "holy cities".

city where two distinct foci existed, in both of which specimens of *Bullinus contortus* were found. One focus was found at Hinaidi Cantonment, during the course of construction work, and the other at Qararah. Both these places are on the left bank of the river close to the city. I have also had two cases among native residents of Karradah, where I have also found a few specimens of the snail host. Karradah, too, is just south of Baghdad. I have also had two cases among orphans living at the American Mission Orphanage at Qararah, between Baghdad and the European Civil Cantonment at Alwiyah.

The occurrence of schistosomiasis at Hinaidi Cantonment is of special importance as this is the British military area, and, had it not been discovered early, a very serious situation might have arisen as regards infestation of both the military, and, to a lesser extent, the native civil population.

After the tribal risings in 1920, two British units, namely, the 2nd Royal Ulster Rifles, and 19th Brigade R.F.A., which had been stationed on the Euphrates in the neighbourhood of Kufah during the last few months of 1920, moved to the Hinaidi Cantonment. In January 1921 three men from these units reported sick with haematuria, and live ova of *Schistosoma haematobium* were found in their urines.

In February 1921, 14 more cases occurred, followed in March by 20 others. Lt. Col. Hamerton R.A.M.C., of the Central Laboratory, Baghdad, caused an examination of all the available men of these units to be carried





KUFAH (EUPHRATES).

out, and, of 495 of the Royal Ulster Rifles systematically examined, 111 were found to be passing numerous ova in their urines, and none of these cases displayed signs or symptoms.

Of the 131st Battery of the 19th Brigade R.F.A., similarly examined, of 36 men, ova were found present in the urines of 11, none of whom complained of symptoms.

Hinaidi Cantonment was at that time in the course of construction, and the land was intersected by sluggish, weedy water channels which were inhabited by snails of various kinds, and among them were found numerous specimens of *Bullinus contortus*. Lt. Col. Hamerton advocated an alternating system of irrigation at the cantonment whereby periodical drying of all channels could occur, and it is interesting to note that since its adoption there have been no cases of schistosomiasis recorded in which infection can be attributed to these channels. Early in 1925, a few cases occurred, but these were all traced to an infested swimming pond which had existed during the summer of 1924.

At Qararah was situated a Remount Depot, and four cases occurred among Indian troops there during 1921, and my two cases, too, in 1922, in the Orphanage situated but a stone's throw from this Depot, seem to point to a definite local infection in this area also.

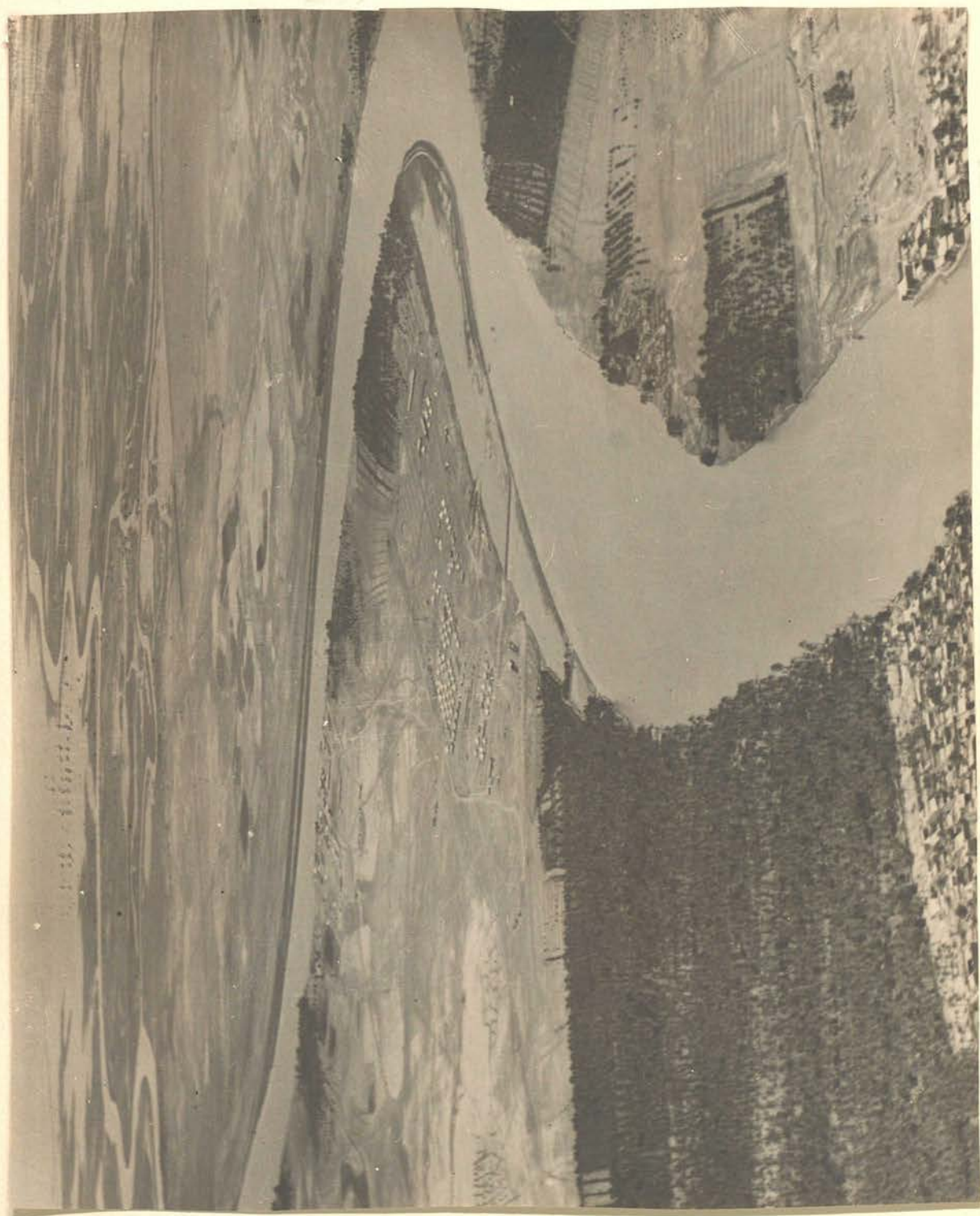
The two cases I met with in Karradah were both fellahs (farm labourers), working and living in that suburb.

Below Baghdad, on the Tigris, there is no import-



ant town above Kut, though a focus of infection has already been noted about Ezra's tomb, a sparsely populated spot, except during the Jewish pilgrimage of early summer. From Kut I have had only one case and from Amarah six cases. Capt. Boulenger, in 1921, examined 39 urines of residents of Amarah, and had 6 positive results, but the late Dr. Sanson, who was Civil Surgeon of Amarah for some 2 years, told me that he considered schistosomiasis to be very rare in this neighbourhood. Below Amarah much flooding of the countryside occurs every year, and there are a number of permanent swamps. The population in this region is, however, very scanty until Qurnah, the traditional site of the Garden of Eden, is reached. At Qurnah, where the Tigris and Euphrates join to form the Shatt-al-Arab, a heavy infestation of the population exists. I have had 7 cases in my hospital wards in Baghdad undoubtedly infested in Qurnah, out of a total number of 11 patients from that town. Records of the town suggest, perhaps, the highest incidence here of all 'Iraq. Capt. Boulenger, in 1918, examined 13 unpicked residents of Qurnah, and without the aid of a centrifuge found 11 of them positive.

On the Euphrates below Hit, I have had 2 positive cases from Ramadi, and 7 from Fellujah. 3 of the Ramadi patients, and 3 of those from Fellujah, presented symptoms, out of a total of 8 and 19 patients examined, respectively. Travelling down river, the next important town is Musaiyib, and, out of 39 patients presenting urinary symptoms, belonging to this district,



A M A R A H. (TIGRIS)

A small part only of the town can be seen, in the foreground.



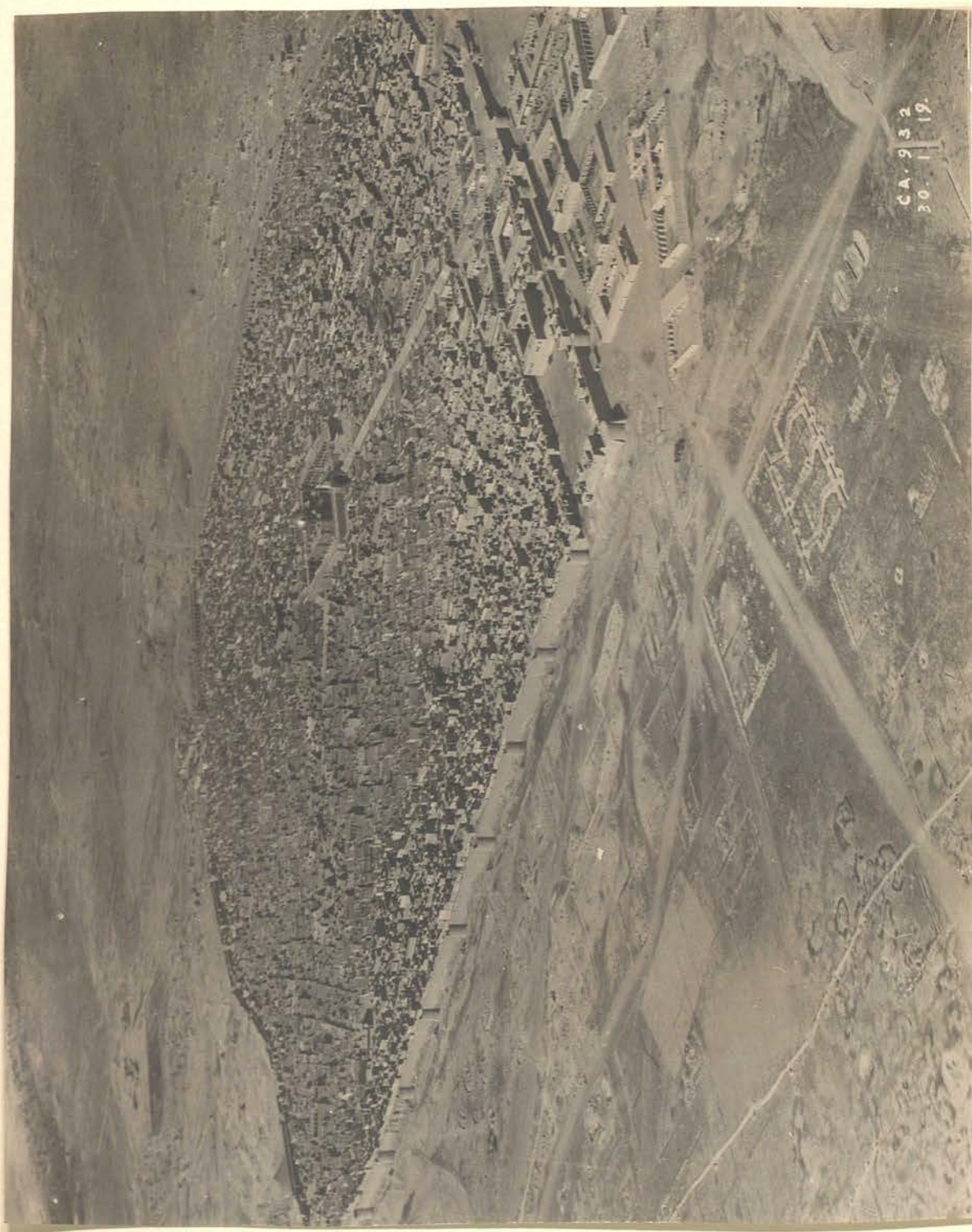
29 proved positive, while of 58 patients without urinary symptoms, 9 only proved positive. The Musaiyib district patients can be further sub-divided into (a) residents of Musaiyib town, & (b) residents of the near neighbourhood. These figures point very definitely to a greater incidence outside the town, which is readily understandable considering that there is relatively little irrigation in the town itself. Fewer of the population in proportion are employed in agricultural pursuits, and more of them wear boots. In the town itself drinking water is drawn directly from the river, whereas outside the town the larger irrigation channels supply most of the drinking water. The figures, sub-divided, give an almost identical percentage incidence in patients presenting urinary symptoms, but a striking difference in patients presenting no urinary symptoms, namely, a percentage of only 4% in the town dweller as against 23% among residents outside, a striking demonstration of the lower incidence among the town dwellers.

8 miles from Musaiyib, and further south, is the village of Hindiyah, the site of the famous barrage constructed for irrigation purposes by Sir William Willcocks for the Ottoman Government. By means of this enormous barrage, the flow of water in the two branches of the Euphrates, which divides here, can be regulated as desired; the eastern division is known as the Hillah branch (Shatt-al-Hillah), and the western one the Hindiyah Branch (Shatt-al-Hindie), and they re-join to form a single river again at Samawah. From

Hindiyah and the few small villages in its neighbourhood, I have had a number of cases; out of 17 presenting urinary symptoms, 14 gave positive results, and of 18 patients with no urinary symptoms, ova were found in the urines of 5 of them. Taking the Hindiyah Branch first, the nearest town of importance is Kerbala, (population 30,000), one of the holy cities. Kerbala is not on the river itself, but lies close to a small tributary of it, and from which it obtains its water supply. Of all towns in 'Iraq none have greater facilities for infestation than Kerbala; the tens of thousands of pilgrims year after year travelling there from all parts of 'Iraq, and from other Mohammedan countries, are an immense problem in the spread of schistosomiasis, not only as a means of carrying infestation to the town and to 'Iraq, but of disseminating it throughout other countries when returning to their homes. Kerbala is a focus of infestation, but, fortunately, a fairly mild one; the reason for this is, I think, the immense amount of salts (mainly sodium chloride) which the soil contains, rendering swampy land and other accumulations of water unfavourable for snail growth. No-where in 'Iraq is so much salt accumulated as in this region, and, during the summer months, it gives the countryside the appearance of being covered by a layer of thin snow.

Of 7 residents with urinary symptoms, whom I have examined from the neighbourhood of Kerbala, only 3 proved positive, while of 43 patients with no symptoms, only 7 proved positive. Continuing southward, on the right





N A J A F.

'Iraq's most important "holy city"; as many as 15,000 corpses, both local and imported, are buried here annually.

bank of Hindiayah Branch is Kufah, (population 3,000), the ancient home of the Imams, and the site of the assassination of Ali, whose death resulted in the great Islamic split. Of 13 patients under my care who presented urinary symptoms, 9 of them were positive, and of 28 without symptoms, 10 cases proved to be infested.

Kifl, (population 2,500), the burial place of the Prophet Ezekiel, is a heavily infested township, and the cause of much dissemination of schistosomiasis amongst Jews who visit it from other towns. I have already noted the occurrence of this condition among the Jews of Baghdad who flock each spring to Kifl to pay homage to the dead prophet. Among residents of the town, too, infestation is heavy. Of 19 patients giving urinary symptoms, 15 had schistosomiasis, and of 46 persons resident there, and symptomless, I found 20 positive on examination. A few miles from Kufah, and to the west of the river, stands Najaf, another of 'Iraq's four Holy cities. Najaf receives her water supply from a stream leading from the Shatt-al-Hindiayah, and most of the water is still carried to the town in goat skins on donkeys.

Najaf (population 30,000), and its surroundings, are not heavily infested; of 8 cases with urinary symptoms, I found 6 positive, while, of those without symptoms, only 4 out of 23 patients were found to have the disease. Close to Najaf, but on the river, and a little south, is a pretty little village, Abu Sukhair, from which place a small stream flows close to Najaf





KIFL. (EUPHRATES).

The burial place of the prophet Ezekiel (Nabi Heskail). Numerous irrigation channels can be seen in the foreground.

and provides the water supply of the latter town.

I spent 24 hours in Abu Sukhair in 1920, and examined the urines of 30 of the inhabitants collected haphazard. 6 of these complained of haematuria and a burning pain on micturition, and all of them proved positive, and 10 of the remaining 24, symptomless, had ova of *Schistosoma haematobium* in their urines.

From a little further south, and as far as Qurnah, the most heavily infested area in 'Iraq, is to be found. Fortunately, the population is sparse in this area of marshland, but very few of the inhabitants of the region are free from the disease. The centre of this area is a small town, Shinafiyah, and of cases that have come under my care, out of 16 with urinary symptoms, 15 were positive, and out of 15 symptomless, 12 were positive. I have confirmed this heavy infestation of the area in conversation with the Civil Surgeons of Najaf and Diwaniyah, and have no hesitation in giving this district first place among the infested districts of 'Iraq.

Continuing southward, the next place of any size is Samawah, where the two branches of the river re-unite. My patients from Samawah district have only been 6 in all, but in spite of the possible fallacy of so small a number, I am inclined to the belief that only a mild degree of infestation exists there. Of 4 patients presenting urinary symptoms 2 proved positive, and the two patients who were symptomless proved negative.

In order to get an idea of the relative incidence among females, after much effort, and many difficulties,



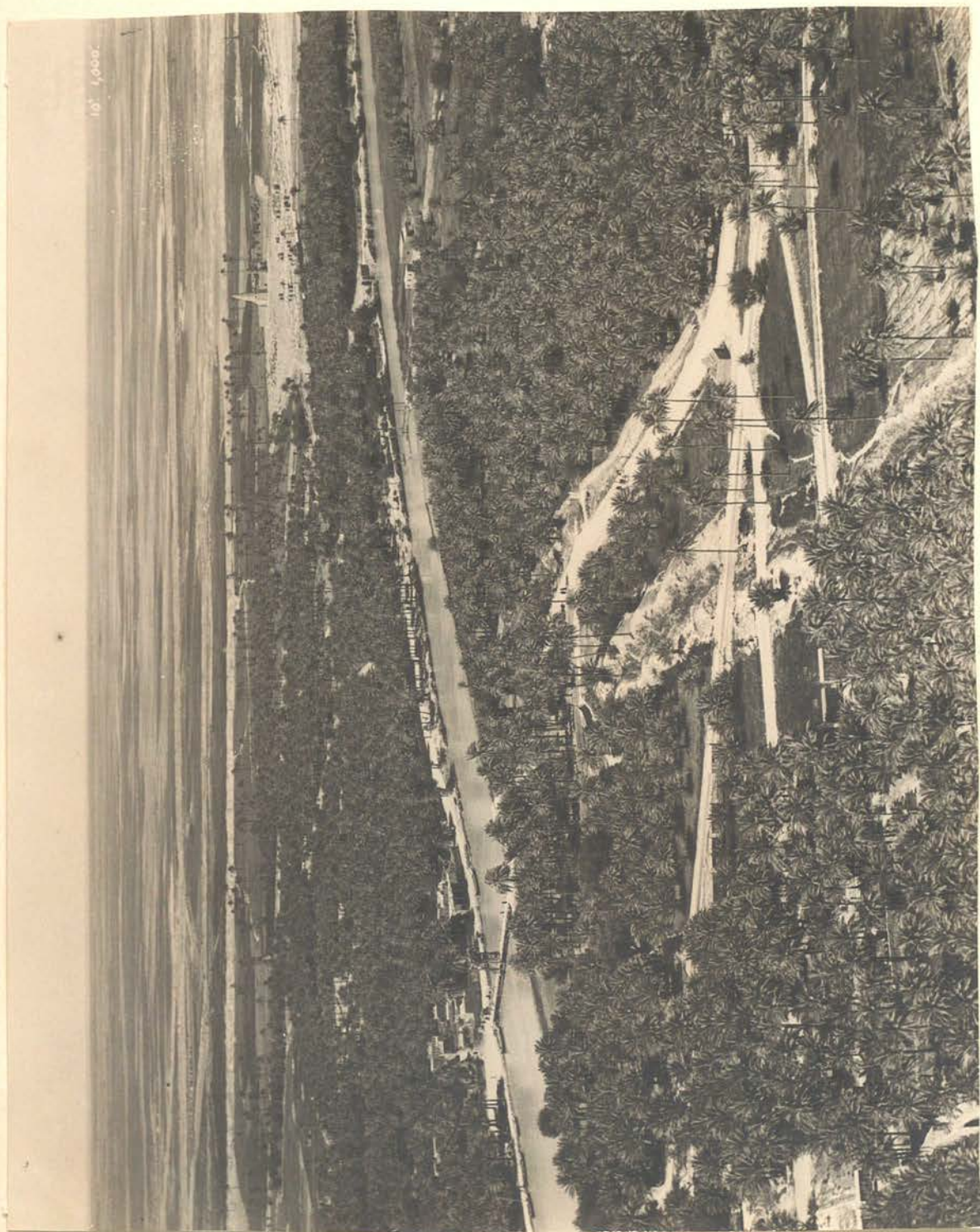
and spread over a period of 8 months, I managed to obtain the urines of 48 adult female patients attending the out-patient department of my hospital in Hillah, and residing in the neighbourhood of Hillah, but outside the town itself, during 1919-20; 6 of these complained of urinary symptoms, and four of them proved positive, while of 42 symptomless, only 4 were voiding ova in their urine. This gives a total percentage of 16.6, as against a percentage of 47.8 in males from the same villages, namely, 45 with symptoms and 38 positive, and 73 symptomless and 18 positive.

Travelling south from Hindiyah along the Hillah branch of the river, Hillah is the first town one meets of any size, and here I investigated the incidence very carefully during my year's Civil Surgeoncy there.

The town of Hillah (population 35,000) is but mildly infested, and the majority of the cases I met with, were probably imported ones. As in the case of Musaiyib, I have separated the figures of the actual town dwellers from those of residents outside. In Hillah town, of 18 cases complaining of urinary symptoms, 12 proved positive to schistosomiasis, while of 112 without symptoms, in 17 only were ova demonstrated in the centrifuged deposit of their urines. Of residents of neighbouring hamlets, out of 45 patients presenting symptoms 38 proved positive, and of 73 symptomless 18 had the disease. These 56 cases were also examined for the presence of intestinal helminths, and the results will be considered in the section dealing with multiple infestations.

HILLAH (MUSAIYIB) (SEE PAGE 62)  
SHOWING RIVER AND DAM BUILDINGS





HILLA. (EUPHRATES).  
Showing river and date gardens.





HILLAH. (EUPHRATES)

View of centre of town.

In the course of my investigations, I examined the urines of 40 of the boys attending the Government School in Hillah, all of whom proved to be residents of the town; 12 urines were found to contain ova, and all these cases were symptomless.

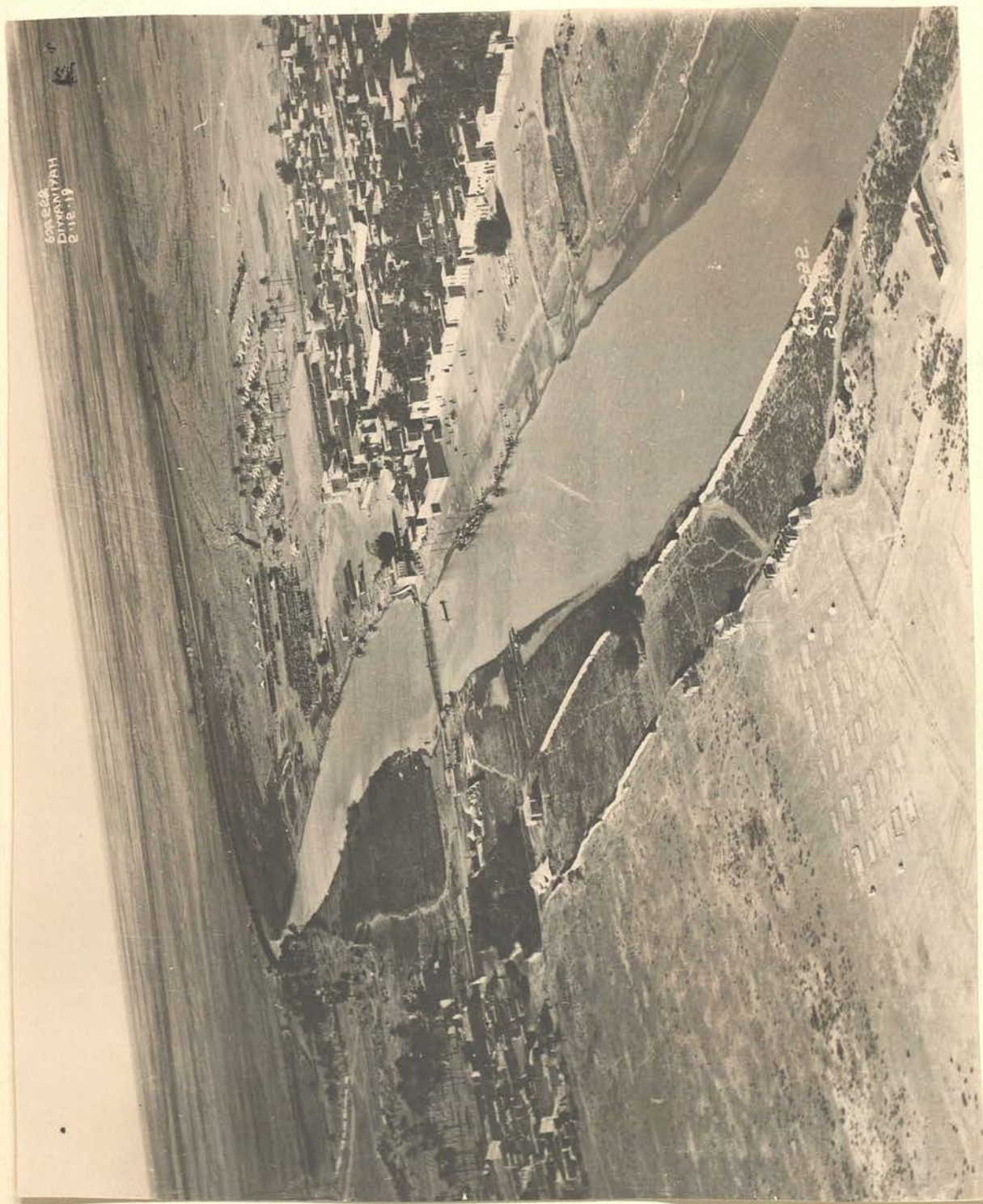
All my statistics point to the highest incidence among boys aged 8 or 9 years, but this subject will be referred to again later.

The ages of these particular positive cases were all between 7 and 10 years as follows :-

AGE.		NO. INFESTED	
7 years	..	1	
8 "	..	4	
9 "	..	5	
10 "	..	2	
Total.		12	====

Southward along the Hillah branch, the next important community is Diwaniyah, the town and neighbourhood of which are very heavily infested, though the smallness of my figures may hardly give a true indication. Of 10 patients with urinary symptoms, 8 proved positive, and 8 out of 18 symptomless patients were found to have live ova in their urines. East and slightly north of Diwaniyah, lies Dagharah, situated on a small tributary, in the neighbourhood of land which becomes marshy in the annual flooding of district. Dagharah shows a similar incidence to Diwaniyah, and out of 9 patients from this district presenting suggestive symptoms, 7 showed ova, while 6, out of 12 who were symptomless, proved positive on microscopic





Diwan Yah  
2.12.19

2.12.19

DIWAN YAH. (EUPHRATES).  
"Helminthic" Zone.

examination.

After junction of the two branches of the Euphrates, and still continuing southward, one next meets Nasiriyah (population 7000), another heavily infested area in the neighbourhood of marshland. Of a total of 33 patients of all kinds from this district, 13 had symptoms, and 10 I found positive, while in 12 of the 20 who were symptomless, I demonstrated living ova. The military authorities in 1918 caused 350 examinations to be made of civil out-patients attending the Civil Dispensary at Nasiriyah for various complaints, and it was found that 163 of these were positive; 47 had urinary symptoms, and 116 had not, giving a total percentage incidence of 47%.

The Civil Surgeon of Nasiriyah, during 1922, examined the urines of all the patients admitted to his hospital, 667 in all. 112 of these were found positive, a percentage of 16. Dr. Ramsay, in 1922, further examined the urines of 135 out-patients of the Civil Hospital, and obtained positive findings in 74% of them.

Before journeying further south along the Shatt-al-Arab, formed near Qurnah by the junction of Tigris and Euphrates, there are four villages between these two rivers deserving of special mention. The first of these is a large village, Mahmudiyah, 20 miles south of Baghdad, through which flows a large canal of the Tigris almost joining the two rivers. Mahmudiyah's population is mainly agricultural, and, as in most other small villages, conditions are favourable for weed growth and so to snail increase. I have had in



small, but Dr. Hall who was Civil Surgeon in Basrah all 20 patients from Mahmudiyah; 8 of these had symptoms during 1920-1922, has given me figures from an investigation he made there during these years, and I propose to quote his figures after recording my own results, in their urines.

Another similar community, but a little further south, is Yoosifiyah, standing on <sup>an</sup> artificial canal of the Tigris of the same name. This village has supplied me with a surprisingly large number of patients, and of 10 presenting urinary symptoms, all were positive, and of 22 symptomless cases, 4 were found to harbour the helminth.

Further south is the river Hai (Shatt-al-Hai), another tributary of the Tigris, and almost a connecting link between the Tigris and Euphrates; two of the villages on its banks have supplied me with patients, namely, Qalat Sikar and Shatrah.

The number of patients has been few in each case, but they have demonstrated a focus of infestation at each place.

From Qalat Sikar I have had but two patients, both with urinary symptoms, and both positive, while from Shatrah, of 4 patients with urinary symptoms, 3 proved positive, and of 6 symptomless, in one only was it possible to discover ova.

I have had no opportunities of investigating the incidence on the banks of the Shatt-al-Arab, but the Basrah about the ages of 8 or 9 years, a similar observation to the one I had already made in school children any size or permanency as one travels south until one reaches Basrah itself.

An examination of a batch of Civil adult prisoners my own figures for Basrah (population 85,000), are



small, but Dr. Hall, who was Civil Surgeon in Basrah during 1920-1922, has given me figures from an investigation he made there during these years, and I propose to quote his figures after recording my own results.

I have had 11 cases from Basrah showing urinary symptoms, and 9 of these proved positive; of 15 Basrah residents symptomless, only 2 gave positive results, but, as 10 of these who proved negative were Jewish merchants, and their mode of life did not expose them much to infection, these figures perhaps serve little purpose, unless they emphasise that it is possible to live in an infested township and still be free from the disease.

Dr. Hall's figures are those of school children, and he found that out of 222 examined in 1920-1921, 140 proved to be infested - a percentage of 66. These children were all Mohammedans.

In 1922 Dr. Hall examined children attending the American School, and his results are of great interest.

In Mohammedan children an incidence of 57 per cent, in Christian children 30 per cent, and in Jewish children 27 per cent; doubtless the higher incidence in the first named class is due to the fact that they bathe in the creeks and canals much more frequently than do the Christians and Jewish children.

Dr. Hall also found the highest incidence in Basrah about the ages of 8 or 9 years, a similar observation to the one I had already made in school children in Hillah.

An examination of a batch of Civil adult prisoners



SHATT - AL - ARAB.  
Neighbourhood of Basrah.

in Basrah resulted in 33 per cent proving positive, and this percentage is consistent with the average number of infested persons among the lower classes of the population. Before concluding the subject of distribution, I want to refer to the original cases which occurred among our troops during the late war, but, before doing so, I wish to emphasise that nearly 95% of the civil patients I have treated for this condition, and on which my figures are based, have belonged to the lower and agricultural classes. Schistosomiasis amongst the upper classes is much rarer, and particularly so in the larger towns. In Baghdad, for example, among the notables I have not met with a case, either Mohammedan, Christian, or Jew, to date. Outside the larger towns too, the better class arab is not to be found bathing or indulging in "river bank sanitation," also boots or shoes are worn by the wealthier classes, and so the risk of infestation minimised.

In Hillah I examined the urines of 30 of the notables of the town, and found no positive case. As already noted, in the larger towns water is laid on in many of the houses, and chlorination is performed after the water is sedimented, but, in the smaller towns, and the villages, the water supply is obtained from the river or from some neighbouring canal, and all classes run a similar risk of infestation by drinking contaminated water. I am convinced that bathing in infested water is, however, a very much commoner cause of infestation than is drinking; it is quite rare to meet with an infested patient who has not bathed in a canal or creek. Basrah is a very favourable locality for the spread



of schistosomiasis, and the first discovery of cases among our troops during the late war was made there in November 1917. The first case found was an Indian bhisti (water carrier) employed at No. 22 Indian General Hospital; he complained of haematuria, and pain on micturition.

The whole of the Indian staff of the Hospital was then examined, and 71 out of 251 men (28%) were found to be infested. A similar examination of British personnel of the Hospital failed to reveal a single case.

No. 22 Indian General Hospital was situated on the Khandaq Creek, a main creek in the Ashar division of Basrah, and all classes of Indian personnel had bathed in the creek during the summer months. At the back of the Hospital were numerous palm groves with their inevitable irrigation channels full of vegetation, a favourite site for the performance of both defaecation and micturition.

Opposite No. 22 Indian General Hospital, and on the other bank of the Creek, were a number of Labour Corps Camps, one of which consisted of coolies imported from Egypt. At first it was thought that the outbreak was due to a spread of infestation from these men, but old Turkish records of nearly 20 years previously revealed the occurrence of this disease in Basrah in 1899, so that, though infestations may have been imported in this way, they cannot be considered to have originated the infestation in Basrah.

Of the 71 cases, 5 only had been out of India previously, and three of these had seen service in Egypt earlier in the war; 13 of the cases were symptomless.

I have been able to obtain further details of the occupations of those affected from military records, and the figures are as follows :-

Occupation.	Total No.	No. Infected	Percentage
(a) Cooks ..	14	9	64
(b) Bhisties (Water Carriers)	18	6	33
(c) Hospital Bearers	69	20	29
(d) Dhobies (Washermen)	12	8	66.6
(e) Storekeepers	8	2	25
(f) Ward Orderlies	48	8	16.6
(g) Sweepers	40	13	32.5
(h) Others (Clerks, ) Tailors, Bullock ) drivers etc). )	16	5	31
Total	225	71	28

These figures suggest that two classes of personnel were most liable to infection, namely, dhobies and cooks, and in each case the explanation is simple. The dhobie ghats (washing places) were on the creek, and the dhobies were in the habit of washing clothes while they themselves were standing in the water.

The temptation of a cool bath to the cooks during a Basrah summer must have been almost irresistible, with a shade temperature of anything up to 120° F. apart from the heat supplied by their cook-houses.

In concluding this subject, I would like to refer to the figure totals for the three zones among the local inhabitants (see tables). No case of schistosomiasis has



A flooded date-grove in Basrah where schistosomiasis is very prevalent.



occured in the first zone, but <sup>in</sup> residents in the second zone, I have examined the urines of 151 persons, and 16 of these have proved positive, a percentage of 10.6.

The third zone can be roughly ~~be~~ divided into three areas; 404 positive results in all were obtained out of a total of 1169 patients, a percentage of 34.5, as follows:-

- (a) Tigris Area, (Samarrah to Amarah), 389 patients and 65 positive, a percentage of 16.9.
- (b) Euphrates Area, (Ramadi to Nasiriyah), 743 patients and 321 positive, a percentage of 43.2, and
- (c) Shatt-al-Arab Area, (Qurnah to Basrah), 37 ~~patients~~ and 18 positive, a percentage of 48.6.

Before considering these figures further, I wish to make a few observations regarding them, as the results are modified somewhat thereby.

- (a) In some cases the number of patients has been so small that the percentage from them can hardly be accepted as definitely being the actual incidence of the whole of the population, though I think the totals obtained from these figures give, with a fair degree of accuracy, the local incidence.
- (b) The patients included in the table have been almost exclusively males; the female incidence is much lower, and would appear from my Hillah figures, already noted, to be not more than 1/3rd of the incidence existing among males.
- (c) Most of one's figures have been obtained from sick persons of one kind or other, and it is possible that a lowered bodily resistance may facilitate

TABLE XI.

## INFESTATION WITH SCHISTOSOMA HAEMATOBIIUM.

## DISTRIBUTION IN 'IRAQ.

District	No. of patients with urinary symptoms.	No. of positive findings.	%	No. of patients without symptoms	No. of positive findings.	%	Total percentage
<u>(a) First Zone</u>							
Turkish & Persian borders.	- - -	Nil	- -	- -	nil	- -	
<u>(b) Second Zone.</u>							
Arbil	5	1	20	27	0	0	4.4
Kirkuk	3	1	33	65	2	3.7	20
Shergat (Tigris)	3	1	33 1/3	7	1	14.3	30
Hit (Euphrates)	2	2	100	8	1	12.5	16.6
Shahraban (Diala)	1	1	100	5	1	20	20
Baqubah (Diala)	4	2	50	21	3	14.3	
Total of Second Zone.	18	8	44.4	133	8	6	10.6

## DISTRIBUTION (Continued).

112

District.	No. of patients with urinary symptoms.	No. of positive findings.	%	No. of patients without symptoms.	No. of positive findings.	%	Total percentage.
(c) Third Zone.							
Samarrah	4	4	100	8	1	12.5	41.6
Baghdad	37	25	67.8	247	0	-	8.8
Karradah	6	2	33.3	4	0	-	20
Mahmudiah	8	8	100	12	2	16.6	50
Yooisifiyah	10	10	100	22	4	18.1	43.7
Kut	3	1	33.3	8	0	-	9
Qalat Sikar	2	2	100	0	0	-	100
Amarah	6	5	83.3	12	1	8.3	33.3
Ramadi	3	1	33.3	5	1	20	25
Fellujah	3	2	66.6	16	5	31.2	36.8
Musaiyib	39	29	74.3	58	9	15.5	39.1
Hindiyyah	17	14	82.3	18	5	27.7	54.2
Hillah	63	50	79.3	185	35	18.9	34.2
Kerbala	7	3	42.8	43	7	16.2	20
Kufah	13	9	69.2	28	10	35.7	46.3
Kifl	19	15	78.9	46	20	43.4	53.8
Najaf	8	6	75	23	4	17.3	32.2
Abu Sukhair	6	6	100	24	10	41.6	53.3
Shinafiyyah	16	15	93.7	15	12	80	87.0
Diwaniyyah	10	8	80	18	8	44.4	57.1
Daghara	9	7	77.7	12	6	50	66.6
Samawah	4	2	50	2	0	-	33.3
Nasiriyyah	13	10	76.9	20	12	60	66.6
Qurnah	8	6	75	3	1	33.3	63.6
Basrah	11	9	81.8	15	2	13.3	42.3
Total Third Zone.	325	249	76.6	844	155	18.3	32.8



infestation; and, further, it may be that one's percentages are increased a little above that of a much higher incidence exists among the Mohammedan population than among the Christians and Jews, and the reasons for this are two in number : urinary symptoms, and who were patients because (1) Christians and Jews are only met with in the largest towns, and, thanks mainly to water control, they are not so exposed to infestation as the Mohammedan tribesmen and cultivators.

(d) The figures quoted only include adult cases; (2) Christians and Jews are on the whole more educated children are not commonly sent for admission to hospital for medical diseases in 'Iraq. I have, in hygienic principles and so do not expose themselves as much to possible infestation. However, given separate figures, not included in the tables, showing schoolboy incidence in Hillah that Europeans are quite as liable to infestation as the local population is shown by the outbreak among and Basrah.

British troops during the late tribal rising in 'Iraq in (e) It has not in many cases been possible to trace the exact locality in which infestation has occurred. That 25% of the troops operating about Kufah for a few months in 1920 should have been found infested is, very striking.

In spite of these possible fallacies the figures show fairly conclusively, I think, how the incidence increases as one travels southward, reaching its maximum at the commencement of the rising in 1920. I held the post of Surgeon of Hillah, and was a member of the garrison there. I wrote to the military authorities in the zone of flat plain in the Euphrates area above Qurnah, an area specially liable to flooding in the early summer, marshy, and luxuriant in vegetation the summer through; here climatic conditions are very favourable to helminthic spread. Somewhat similar conditions exist at Basrah, where the irrigation of the creeks and small irrigation channels is entirely tidal, and there is always much accumulation of water about the groves of date palms. Such conditions are very favourable to the spread of schistosomiasis, and to malaria which is very prevalent, and commonly malignant in character.

## SEX &amp; RACE INCIDENCE OF SCHISTOSOMIASIS.

A much higher incidence exists among the Mohammedan population than among the Christians and Jews, and the reasons for this are two in number :

(1) Christians and Jews are only met with in the largest towns, and, thanks mainly to water control, they are not so exposed to infestation as the Mohammedan tribesmen and cultivators.

(2) Christians and Jews are on the whole more educated in hygienic principles, and so do not expose themselves as much to possible infestation.

That Europeans are quite as liable to infestation as is the local population is shown by the outbreak among British troops during the late tribal rising in 'Iraq in 1920. That 25% of the troops operating about Kufah for a few months in 1920 should have been found infested is, I think, very striking.

At the commencement of the rising in 1920, I held the Civil Surgeoncy of Hillah, and was a member of the garrison besieged there. I wrote to the military authorities informing them that the town and district ~~were~~ infested, and suggested that bathing in the rivers and creeks be forbidden, and that precautions be taken to ensure a safe drinking supply. These figures do not suggest, however, that my advice bore much fruit.



Flooded country in the lower Euphrates area. Snipe abound and when such water is infested with Schistosome larvae it presents a serious menace to sportsmen.



to mor PATHOLOGY. egg-deposition.

The pathological lesions resulting from infestation with *Schistosoma haematobium* naturally vary very widely, depending on the chronicity of the disease, and on its intensity, though the bladder is invariably affected to some extent once the disease is definitely established. The earliest sign visible to the naked eye is a number of minute papules surrounded by a reddish area of congestion. I have met with this phenomenon several times at post-mortem examinations in which the cause of death was not connected with schistosomiasis, nor had the infestation suggested itself, either symptomatically, or on urinary examination. Usually these papules are to be found about the trigone of the bladder, and they are commonly limited to this area.

In later stages of the disease, papules may increase in size and form irregular dense patches; these patches are superficially granular, and, on section, give a curious gritty sensation. As time goes on the congestion of the patches tends to diminish, leaving the affected portions of mucous membrane yellowish brown in colour, and with a granular surface, the well known "sandy patches."

Vesical papillomata occasionally form in the bladder, and, when present, they take origin from these indurated patches. I have seen two forms of papilloma in 'Iraq, namely (a) a small sessile tumour, and (b) a true adenopapilloma which is liable to take on malignant characteristics.

In some cases there is a wider affection of the bladder mucosa than is seen in the papular variety, due

to more uniform egg-deposition.

In these cases a granular and much thickened mucosa is associated with increase in the secretion of mucus. These cases, which in my experience are not uncommon, usually, especially if old standing, show, in addition, thickening of the muscular coats of the bladder, and, if excessive, may transform the bladder into a spherical mass with a very diminished capacity.

One of the cases which came under my care in Hillah was an excellent example of this, Jassim ibn Hassan, aged 40 years, a resident of Diwaniyah. I have only met with such cases of bladder hypertrophy in the highly infested areas of the Euphrates. In the case just mentioned, in addition to ova, on sounding the bladder, the presence of a stone was felt; the suspicion of the presence of a stone was caused by a hard spherical mass felt on supra-pubic palpation. I decided that this was a huge calculus, and I was very surprised at the extraordinary thickness of the bladder when I cut through it during operation and found the cavity very small, and only a small irregular phosphatic concretion, about an inch long, embedded in the roughened bladder wall. The remainder of the inside of the bladder was covered with a thick dark brown layer of mucus in which was deposited a large amount of minute phosphatic gravel.

The papules on section show inflammatory reaction in which numbers of eosinophil leucocytes are present, and numbers of ova are scattered throughout the submucous, mucous, and muscular layers of the bladder, though principally in the first of these.

Until recently, it was generally believed that rectal symptoms, and especially the formation of polypoid papillomatous condition of their surface on microscopical examination of sections and, as already noted, it is from these patches that papillomata may spring in old standing cases.

I have only experienced one case in which a ureter had developed a papilloma. Naturally such a lesion, though of little consequence in itself, may be of very serious importance in a structure with such a fine lumen as a ureter, and so in cases of ureteric involvement the outlook is very grave; hydronephrosis, renal atrophy, and sepsis, may follow.

My patient was aged 30 years, and a master at one of the Government Schools in Baghdad. He was admitted to the New General Hospital, on 20th November 1922, complaining of "harrij bol" (hot urine). He was a resident of Mahmudiyah, and had had his symptoms for some 5 years. Ova of *Schistosoma haematobium* were found in the urine, together with blood and pus cells. On closer investigation occasional attacks of pain, resembling renal colic, were complained of in the right side.

An XRay examination was made and a ureteral calculus diagnosed. Dr. Woodman, Surgeon to the Hospital, operated on the patient on 23rd November, and found both a calculus and a small papilloma, the latter preventing the onward passage of the calculus. The papilloma was near the vesical end of the ureter, and, on section, it was found to contain numerous ova, many of which were undergoing calcification.



Until recently, it was generally believed that rectal symptoms, and especially the formation of polypoid growths, was an exclusive characteristic of infestation with *Schistosoma mansoni*, but a case under my care was proved beyond question that *Schistosoma haematobium* can, and does, on occasion, form papillomata.

Three cases of this nature have to date been noted in 'Iraq, and ova of *Schistosoma haematobium* found in all three on section, but in the case reported by Dr. Mills and myself, not only were ova found, but also adult worms in copula within the growth.

The figures on the two pages following show sections of the growth. They were originally drawn from the actual specimens by my wife. They are reprints from the article above mentioned, and depict the main points in the pathology of the condition.

The patient, Hassan ibn Bassam, aged 26, a Kurdish coolie from Arbil, was admitted to the New General Hospital, Baghdad, on January 24th 1923 with a diagnosis of "Anaemia" of 3 months' duration. He had only left Arbil for the first time 6 months previously for Baghdad, and had since that time been engaged in coolie work on the new cantonment in course of construction at Hinaidi.

The patient insisted that he had been free from any symptoms of schistosomiasis until three months previous to admission; he then noticed a burning pain on micturition, followed a month later by haematuria towards the end of the act. A week later he noticed tenesmus associated with blood and mucus in the stools.

The patient, a well build man, was pale and obviously very ill on admission; the spleen was enlarged, haemic

# RECTAL PAPILLOMATA IN SCHISTOSOMA HAEMATOBIIUM INFESTATIONS.

BY

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FIG. 1.—Longitudinal section from the hypertrophic adenomatous portion of the growth, showing the papillomatous prolongations and numerous deeply stained ova in the tissues. Fixed in formol saline and stained with Ehrlich's acid haematoxylin and orange "G." ( $\times 44$ .)

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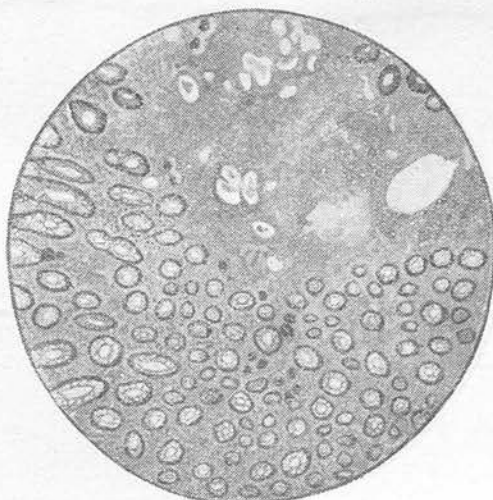


FIG. 2.—Transverse section of the adenomatous portion of the growth. Tissue fixed and stained as in Fig. 1. ( $\times 44$ .)

cardiac murmurs were present, and a number of râles discernible at both pulmonary bases. The temperature was slightly elevated, and the pulse rate 96. The result of a total and differential blood count was as follows:-

Haemoglobin 60 percent, red blood corpuscles 3,235,000 per cubic millimetre, giving a colour index of just under 1. There was a moderate degree of leucocytosis (13,800), the percentage of the respective white elements present being :-

Polymorphonuclear leucocytes	.. 55.4%
Lymphocytes	.. 26.6%
Large mononuclear leucocytes	.. 5.2%
Eosinophil leucocytes	.. 12.8%

The patient at the time of admission was passing from six to ten motions daily. Naked eye examination of the stools showed the presence of both blood and mucus, a solid core with a marked peripheral radiating structure the former dark in colour, free, and greatly in excess of the latter, and, microscopically, the presence of an enormous number of the typical ova of *Schistosoma*

microscopically, sections taken from the periphery of the tumour showed an advanced hypertrophic condition

Examination of a centrifuged deposit of urine of the rectal glandular tissue, with the formation in showed many pus and red blood cells, and a large number places of long papillomatous prolongations of the mucosa, of terminally spined ova. I performed a digital examina-

The supporting structure was loose, and consisted of delicate strands of fibrous tissue, between which just within range of my finger, and the presence of the were to be seen numerous cells of the mononuclear type. tumour was confirmed by sigmoidoscopic examination.

Young thin-walled blood vessels were plentiful, and in The growth was removed by Dr. Woodman on February 17th.

a condition of marked engorgement. In several places Sodium antimony tartrate was administered intravenously small collections of ova with deep-staining miracidia on alternate days, and, after the administration of 30 were to be seen in the inter-glandular tissue, and in grains in all, the patient was discharged apparently the neighbourhood of such collections the cellular content completely cured.



of the tissue was different, the majority of the cells in those situations consisting of polymorphonuclear leucocytes of the eosinophil type. In the transitional area between the adenomatous and the more centrally placed portion of the tissue were collections of ova, which, from the failure of the miracidia to take the nuclear stain, suggested an older appearance than those already noted in the papillomatous portion. In such areas we found that the particular stimulus determining the calling forth of the eosinophil polymorphonuclear elements had ceased, the cells found in these sites being chiefly of the mononuclear type. Here also stimulation of the fibroblastic elements had taken place, with marked production of fibrous tissue, and resulting attempts at encapsulation of the collections of ova.

Sections taken from certain of the superficial portions of the growth failed to show the adenomatous structure above described; it was replaced by a tissue presenting the appearance of granulation tissue in which numerous ova were present; blood vessels were numerous, and ulceration of the surface was apparently occurring. It appeared as if it was from areas such as these that emigration of ova into the lumen of the bowel was occurring, which lead us to think that they were the source

The central portion of the growth showed entire absence of the glandular structure characterising the peripheral portion already described.

The fibrous tissue elements showed considerable increase, forming a well marked stroma in which numerous ova of various ages were embedded. Here again variation

in the cellular content of the tissue was to be noted; in the proximity of ova containing miracidia which stained well the infiltrating cellular type was that of the eosinophil polymorpho-nuclear leucocyte. In the neighbourhood of ova showing degeneration of these miracidia, evidenced by the absence of nuclear staining, the predominant cell was that of the mononuclear type.

In some of the sections ova were present in very large numbers; in one particular area as many as sixty ova were visible in the field given by an objective Leitz No.3, with ocular No.2.

Apart from the fact that numerous terminally spined ova were found in the stool, it was considered necessary to search sections in the endeavour to find an embedded ovum cut longitudinally through the middle line, showing beyond any doubt the presence of the terminal spine. In due course a fine specimen was found (figure 3).

The complete contained miracidium is unfortunately not shown, but the specimen demonstrates the terminal spine very clearly. No evidence whatever was obtained after prolonged search of any ova showing the slightest suggestion of lateral spines (*Schistosoma mansoni*).

Certain structures were seen lying within the blood vessels, which lead us to think that they were the transverse sections of the terminal portion of a trematode worm. Further search in other sections from the same tissue finally led to the discovery of typical transverse sections of the helminths themselves lying within the blood vessels, and presenting the characteristic arrangement of the male and female worms in copula (figure 4).

From the histo-pathological examination the polypoid growth revealed itself as being of the nature of a papillo-adenoma, and apparently <sup>the stimulus producing</sup> the hypertrophic condition of the rectal mucosa was the presence in the tissues of numerous ova of *Schistosoma haematobium*, and also possibly certain toxic substances secreted by the adult worms themselves, whilst lying in the terminal ramifications of the haemorrhoidal vessels.

#### DIAGNOSIS.

Diagnosis of infestation with *Schistosoma haematobium* is not as a rule difficult, and the finding of terminal spined ova in the urine is conclusive. There are many cases, however, in my experience, in which symptoms are present or so slight as to pass un-noticed by the patient himself. In these cases the discovery of the presence of the disease is commonly made by accident in the course of a routine urinary examination.

Great care must be exercised in not designating the whole of the symptoms presented to schistosomiasis without due regard to the possibility of the co-existence of other diseases such as calculus, cystitis, and vesical tumour. This point cannot, I think, be too strongly insisted.

Europeans, except under active service conditions, are usually infested with schistosomiasis when on shooting trips, snipe and duck shooting in particular. I have not met with a serious case in a European in 'Iraq, and I attribute this to the lesser likelihood of re-infestation in them.

Usually the degree of anaemia is slight, but on the





Two Schistosomiasis cases of moderate severity.

lower Euphrates, where the greatest intensity exists, I have noticed a curious muddy complexion in a large number of patients, particularly in those from the region of Dagharah. As will be seen in a later chapter, ankylostomiasis, too, is rife in this area, so that the complexion changes, may, in some cases, be due to the latter disease, though I think the two complexions are readily distinguishable. In cases in which repeated examination of the stools failed to reveal ankylostome ova, the muddy complexion has been found, and not<sup>at</sup> all similar to the waxy pallor of the face, and pearly white conjunctivae, so characteristic of a moderately severe ankylostomiasis victim.

Clinical diagnosis of schistosomiasis is not very conclusive in the absence of laboratory confirmation. Laboratory diagnosis is very simple as all that is needed is to allow urine to stand until its sediment has settled, or for it to be centrifugalised; the ova can be readily seen with the low power of the microscope.

When on tour I found it very convenient to carry test-tubes, standing in a box containing cotton wool, and, when I had obtained my specimens, each was corked, labelled, and packed firmly, and examined as soon as I returned home. This method I found more satisfactory than to take my microscope with me, as I had no portable centrifuge, and hence a delay of some hours was needed for sedimentation to occur before microscopic examination could be made.

I have found cystoscopic examination of great value in early cases before ova have begun to appear in the

usually causes the shells to burst, and the miracidia to urine, and in later cases where ova could not be found, be discharged and display motion if alive. for papules are often present before ova are found in the urine.

When septic complications have occurred, the urine is usually alkaline in reaction, and it rapidly becomes ammoniacal on standing.

In my experience the first morning urine is much more likely to prove positive in doubtful cases than

urine passed at any other time, presumably, as there is the faeces it is only in the outer layers of the stool, usually a longer interval between acts of micturition or in any mucus covering that ova are likely to be found, in which concentration can occur.

Microscopically, the urine varies within very wide limits. There may be no evidence of blood, or blood may, contained large numbers of ova. Such acute dysenteric as most commonly happens if it is present, be passed in symptoms are, however, unusual, and the cases in which the last portion of the urine only, though I have met with quite a number of cases in which the whole of the stools which have had a layer of mucus sticking to the voided urine was blood stained.

The specific gravity of the urine does not vary very much in uncomplicated cases, and in early cases it is usually acid in reaction. Pus and red blood cells, together with the typical ova, form the usual microscopical picture; uric acid, urates, and calcium oxalate crystals, have also been present in a large number of my cases.

In patients under treatment it is often of importance to know if the miracidia are alive or dead. A blackened ovum signifies death of the contained miracidium, but, on the other hand, a miracidium which is motionless is not necessarily dead. The miracidia of live ova can readily be hatched out if warm water, which lowers the osmotic pressure, is added to the urine, and I have found also that pressure with a pair of forceps applied to the cover slip of one's specimen under the microscope,



usually causes the shells to burst, and the miracidia to be discharged, and display motion if alive. but failed to find When septic complications have occurred, the urine is usually alkaline in re-action, and it rapidly becomes ammoniacal on standing. In searching for ova of *Schistosoma haematobium* in the faeces, it is only in the outer layers of the stool, or in any mucus covering, that ova are likely to be found. In the case of Hassan ibn Bassam, already described, acute dysenteric symptoms were present, and the whole motions contained large numbers of ova. Such acute dysenteric symptoms are, however, unusual, and the cases in which I have demonstrated ova have usually had well formed stools, which have had a layer of mucus sticking to the outside, and it has been in the mucus covering that ova have been found most plentifully. at Zaur (Tigris, south of Baghdad).

#### THE MOLLUSCAN FAUNA OF 'IRAQ.

My own investigations have resulted in the finding As already noted, a snail host is necessary in the life history of *Schistosoma haematobium*. It was formerly supposed that human schistosomiasis could be transmitted directly, but Leiper's work in Egypt early in the war resulted in the finding of molluscan hosts, and there can be little doubt that a mollusc is invariably needed to play the part of intermediate host. For some time during the late war a great deal of doubt existed as to the existence of a mollusc host in 'Iraq. In the neighbourhood of Hillah I have found local concentrations of this mollusc and then, for no apparently accountable reason, a similar countryside has failed to reveal occurred among Indian personnel of No. 22 Indian General Hospital during the autumn of 1917, Capt. Boulenger,

Following the outbreak of schistosomiasis which occurred among Indian personnel of No. 22 Indian General Hospital during the autumn of 1917, Capt. Boulenger,

Protozoologist to the British Expeditionary Force in Mesopotamia, searched Basrah for molluscs, but failed to find a single specimen of *Bullinus*, and he came to the conclusion that it was non-existent. Capt. Boulenger found a number of specimens of *Planorbis*, but I imagine these were of the species *convexusculus* as this is the only species of mollusc of the genus *Planorbis* which has been identified in 'Iraq to date. This observer further in fact, apart from schistosomiasis, I think he found the thought that this gastropod was probably an intermediate relative immunity from malaria is to no small extent due host, though he failed to find an infested specimen.

In the following year, Capt. Boulenger reported the finding of snails of the genus *Bullinus*, and modified his views accordingly. He was on tour during the winter months, and found empty shells only; these he encountered at Amarah, in empty irrigation channels, in a dried marsh at Fellujah (Euphrates), and at Zaur (Tigris, south of Baghdad).

My own investigations have resulted in the finding of specimens of this snail in Baghdad, Baqubah, Hillah, Kufah, Diwaniyah, and Basrah, and as military medical authorities found similar specimens in Samarra and Nasiriyah, I think the wide distribution of this snail throughout 'Iraq is conclusively proved.

Compared with Egypt, this snail is probably not nearly as profusely distributed; in fact, it has a curiously local distribution in 'Iraq. In the neighbourhood of Hillah I have found local concentrations of this mollusc, and then, for no apparently accountable reason, a similar countryside has failed to reveal a single specimen.

I am inclined to believe that the salinity of the soil is a big factor on this curious distribution. *Bullinus* will not thrive in brackish water, and a high salinity is a feature of many parts of the country where water collects; about Baghdad on the Tigris, and Kerbala on the Euphrates, the degree of salinity attained by accumulation of water is both interesting and surprising. In fact, apart from schistosomiasis, I think Baghdad's relative immunity from malaria is to no small extent due to this phenomenon, as anopheles also do not flourish in brackish accumulations of water.

It was while on a malarial survey in Hillah in 1920 that this high percentage of salinity in seepage and other surface water first attracted my attention.

There were two enormous areas of seepage water outside the town, and malaria was rife, and the question of removal of these breeding grounds of anopheles presented itself. Expense was a big draw-back to any scheme at the time, and, perceiving the neighbourhood white with crystallised salt deposits, I thought of converting the accumulation into lakes of sufficient salinity as to prevent mosquito breeding. The experiments I conducted hardly fall within the range of this thesis, but an examination of the water revealed a salinity of over 1%, and a most careful search failed to find a single specimen of *Bullinus*, whereas more recent and smaller accumulations of water nearby were productive of a number of specimens of this mollusc.

Boulenger identified the snails he found in Basrah in 1917 as specimens of *Limnea*, *Planorbis*, *Melania*.



tuberculata, and *Melanopsis nodosa*, all of which he found abundant in the creeks and irrigation channels of the neighbourhood. The species of *Limnea* and *Planorbis* were not named, but, with regard to the latter, as already noted, only one species of this snail, namely, *Planorbis convexiusculus* has as yet been identified in 'Iraq, so that it was probably the species met with by this observer.

Lt. Col. W. H. Lane, Commanding the 1/94th Battalion, Russell's Infantry, and stationed at Samarra (Tigris), found numerous shells of *Bullinus contortus* early in 1918 on the left bank of the river there.

The military authorities at Nasiriyah made a collection of the molluscan fauna of the latter district, and sent them to India for identification.

Dr. Annandale of Calcutta, Director of Zoological Survey of India, named the specimens of the two collections as follows :-

1. *Neritina jordani*.
2. *Melania tuberculata*.
3. *Melanopsis nodosa*.
4. *Limnea ovata*.
5. *Limnea trunculata*.
6. *Planorbis convexiusculus*.
7. *Bullinus contortus*.

Dr. Annandale noted that some specimens of *Bullinus schistosoma mansonii* does exist in this country it is, sent from Nasiriyah seemed to belong to a new variety, but that those from Samarra were absolutely identical with specimens from the river Nile.

Following the outbreak of schistosomiasis in the Hinaidi Military Cantonment in 1921, Lt. Col. A. E. Hamerton,

I found a few specimens in the cantonment in the autumn R.A.M.C. of the Central Laboratory, Baghdad, searched the of 1921, but military prophylactic measures had reduced cantonment area for possible snail hosts in case a focus the snail population to a very sparse one by this time, of infestation might be in process of formation there.

I was in Basrah on leave during May 1920 and I found Colonel Hamerton obtained a number of different a number of specimens of *Bullinus* in date gardens in varieties of snails, and these were sent to the British Ashar. I kept a number of these snails under observa- Museum for identification. Examination by an expert tion for some weeks in test tubes two thirds filled with malacologist resulted in these snails being identified water, but in no instance did I find any cercariae as follows :-

escape from them. I carried out some snail dissections

1. *Bullinus contortus*.

with similar negative results. The latter is naturally

2. *Planorbis* (? species).

a quicker method of finding if cercariae are present in

3. *Limnea persica*.

the liver of a mollusc, but the first named method is

4. *Fruticola obstructa*.

simpler, and, I think, equally reliable if there is no

5. *Melanopsis nodosa*.

urgency about one's investigations. The cercariae are

6. *Ena petracus*.

just visible to the naked eye and can be readily identi-

Numbers 1, 3, and 4, above had been obtained in profusion fied by the 1/6 inch lens of the microscope.

but 2, 5, and 6, were not found to be common in the area.

I found, too, a few specimens of *Planorbis convexus*.

Colonel Hamerton examined some hundreds of the snails,

culus in the irrigation channels, and a large number of

but none were found infested with larval parasites.

*Limnea* (doubtful species), and *Melania tuberculata*.

Colonel Hamerton found two specimens, possibly *Planorbis*

from one of the specimens of *Planorbis* a large number

*boissyi*, after a prolonged search in the district of

of cercariae, not of *Schistosoma haematobium*, however,

Baghdad, and I think, this is the only suspicion there

were seen in the water of the containing test tube after

has as yet been of the occurrence of this mollusc in

ten days of captivity.

'Iraq. No other military observers reported it, and I have

In the Hillah district, during 1919-1920, I searched

not met with it anywhere, and if the snail host of

the whole area between Musaiyib, to the north, Kerkala,

*Schistosoma mansoni* does exist in this country it is,

to the west, Hillah, to the east, and Diwaniyah to the

I suggest, without any serious menace to public health

south. From the neighbourhood of each of the last three

at present.

towns I found numerous specimens of *Bullinus contortus*.

In the neighbourhood of Baghdad, I have found speci-

With the exception of a few of these molluscs found just

mens of *Bullinus contortus* in date gardens in Qararah on

north of Hillah on the left bank of the river they were

the way to Hinaidi, and, following Colonel Hamerton,

I found a few specimens in the cantonment in the autumn of 1921, but military prophylactic measures had reduced the snail population to a very sparse one by this time.

I was in Basrah on leave during May 1920, and I found a number of specimens of *Bullinus* in date gardens in Ashar. I kept a number of these snails under observation for some weeks in test tubes two thirds filled with water, but in no instance did I find any cercariae escape from them. I carried out some snail dissections with similar negative results. The latter is naturally a quicker method of finding if cercariae are present in the liver of a mollusc, but the first named method is simpler, and, I think, equally reliable if there is no urgency about one's investigations. The cercariae are just visible to the naked eye, and can be readily identified by the 1/6 inch lens of the microscope.

I found, too, a few specimens of *Planorbis convexiusculus* in the irrigation channels, and a large number of *Limnaea* (doubtful species), and *Melania tuberculata*. From one of the specimens of *Planorbis* a large number of cercariae, not of *Schistosoma haematobium*, however, were seen in the water of the containing test tube after ten days of captivity.

In the Hillah district, during 1919-1920, I searched the whole area between Musaiyib, to the north, Kerbala, to the west, Hillah, to the east, and Diwaniyah to the south. From the neighbourhood of each of the last three towns I found numerous specimens of *Bullinus contortus*. With the exception of a few of these molluscs found just north of Hillah on the left bank of the river, they were



found exclusively in irrigation channels in date gardens, but very localised in their distribution.

I was not successful in finding any specimens of *Bullinus contortus* in the neighbourhood of Musaiyib, but I found a number of the other commoner snails of genera *Limnaea* and *Melania*. On the Euphrates, during the rising of the tribesmen in 1920, I lost some of my specimens which had not been identified, but all the common snails already mentioned were identified, and two unknown specimens I sent to England for identification through Colonel Hamerton, these been named by Dr. G.C. Robson, Malacologist to the British Museum as :-

1. *Corbicula cor.*

2. *Melania bullio.*

With regard to the latter Dr. Robson says "This is a representative of a very polymorphic species, which German considers to be separate, but I think may eventually be shewn to be a form of *Melania cordata*".

Specimens of neither of these molluscs have been reported to date from other parts of 'Iraq.

Two of the specimens of *Bullinus contortus* which I found in the Hillah district, both found in the same irrigation channel in Kifl in July 1919, proved to contain cercariae of *Schistosoma haematobium* on dissection, but these were the only two positive findings I had in some 40 dissections, and the only positive results I have had to date.

The neighbourhoods of Kufah and Kifl supplied me with specimens of *Bullinus* more readily than any other places, and there is no doubt that this area represents

one of the areas of 'Iraq most heavily infested with varieties of human schistosomiasis are specific, and schistosomiasis.

In November 1922, while on a visit to Baqubah, I found shells of *Bullinus contortus* in a dried irrigation channel in a fruit garden, on the left bank of the Diala. In a weedy channel of the same garden, I also found numbers of live specimens of *Fruticola obstructa*, empty shells of this mollusc floating on the surface of regard to their mantle; in the former the mantle covers the water, and collected into masses by the luxuriant weed growth of the irrigation channel. *Fruticola obstructa* is usually described as a land snail, but, in

'Iraq, it certainly has claims to be considered semi-aquatic. This is possibly an adaptation to environment to which they may be found adhering during the summer on account of the method of irrigation employed.

Areas of cultivation being frequently flooded results *Planorbis* in 'Iraq occurs in March and April. *Planorbis* in a land snail either adapting itself to the new conditions, or in it becoming extinct.

I searched the river banks, too, at Baqubah. There were many weeds growing by the river's edge, and on the water. The young snails take about 3 months to hatch, and in 'Iraq the most favourable time for snail collecting is from June to November. After November the snail vanishes and one's chances of finding a living *Bullinus contortus* acts as an intermediate host of *Schistosoma haematobium*, but, in Egypt, other species of *Bullinus*, namely *B. dybowskii* and *B. innesi* have been found infested. It has not been conclusively proved, however, that these two molluscs are other than forms of *Bullinus contortus* which is sometimes very variable.

It is of great importance from the aspect of pre-

ventive medicine to know if the hosts of the three varieties of human schistosomiasis are specific, and it certainly seems that if they are not actually specific in each case they are very nearly so. The *Bullinus* (synonym *Isidora*), from which *Physopsis* is only doubtfully separate, is recognised by its left hand spiral, and is easily confused with the genus *Physa*, which is usually considered to be separate from it. *Bullinus* and *Physa*, however, differ markedly with regard to their mantle; in the former, the mantle covers a large part of the shell in the living animal, whereas, in the latter, it does not extend over the shell.

The genus *Bullinus* is usually found in clearer water than is *Planorbis*, but both feed on aquatic plants to which they may be found adhering during the summer months. The main breeding season of *Bullinus* and *Planorbis* in 'Iraq occurs in March and April. *Planorbis* usually deposits its egg masses on the shell of another individual of the same genus, while *Bullinus* lays its eggs on stones or other solid matter at the bottom of the water. The young snails take about 3 months to hatch, and in 'Iraq the most favourable time for snail collecting is from June to November. After November the snail vanishes, and one's chances of finding a living specimen during the winter months are very remote, though empty shells are quite commonly met with.

During the spring months in 'Iraq the rivers rise, and parts of the country, in the lower Euphrates and Tigris in particular, overflow their banks and turn the countryside into swamps which gradually dry up in the



hot sun of the summer. This flooding of the country, occurring as it does at the time of snail breeding, causes an annual migration of young snails to distant parts, and this is, I believe, an important factor in the spread of schistosomiasis in 'Iraq; the most flooded parts receive the most snails, and these are the districts where the incidence of schistosomiasis is found to be highest.

#### SYMPTOMATOLOGY.

In common with other helminthic diseases, the infested person may be free from any symptoms suggesting the presence of a parasite, and I estimate that in 'Iraqis only about 20% of those infested present symptoms, and this percentage has proved to be practically the same among British troops who have been infested in the country.

The symptoms presented by patients in 'Iraq are similar to those noted in other infested countries, and they vary within very wide limits. The disease in 'Iraq is, however, only occasionally fatal; reference will be made later to two such fatal cases admitted to my wards.

The most characteristic symptom associated with infestation with *Schistosoma haematobium* in 'Iraq is the passage of blood at the end of the micturition; this haematuria may be unaccompanied by any sense of irritation, but more commonly a sense of irritation is present during the act. My figures give a percentage of 72 for the number of patients whose haematuria is associated with a sense of urinary irritation, but, I think, it is worthy of special note that as many as

28% of cases with this haematuria did not complain of any pain. Usually, it is only the last few drops of urine that contain blood, but in very heavily infested cases the whole urine may be blood tinged, and I have seen a number of such cases from the lower Euphrates district, and, in two of these cases, clots formed in the bladder, and caused retention of urine which was only overcome by catheterisation, and by washing out the bladder.

Associated with the haematuria, or even without it, a sensation of burning or irritation is common during micturition. In 'Iraq this is known colloquially as "harrij bol" (burning urine), and it is a recognised local clinical entity. The village hakeems (unqualified doctors) base much of their reputations on their ability to cure this condition, but, judging by the numbers that now apply for treatment at civil dispensaries, the local hakeem has certainly not discovered a very satisfactory remedy. Cauterisation of the anterior abdominal wall with red hot irons is the commonest treatment given by them. In the course of every clinical examination I ask if "harrij bol" has been experienced, and it is not uncommon for it to be revealed on interrogation, but so accustomed has the patient become to its existence that he has not thought of enquiring if anything could be done for its relief. There does not appear to be any very definite incubation period in this disease in 'Iraq, and I have noted cases as soon as 3 months, and as late as 3 years, after exposure to infestation.

The amount of haematuria, and of "harrij bol", is influenced by the mode of life of the patient, and is aggravated by dietary indiscretions, which irritate the bladder, and by exercise. This "Harrij bol" is usually noticed towards the end of micturition, but as time goes on it is liable to be present between acts; it is, however, almost invariably increased during the passage of urine. This burning sensation leads very commonly to frequency of micturition. The passage of blood is frequently intermittent, and its gradual increase is usually an indication of a more extensive implication of the bladder wall. Pain, as distinct from irritation is, in uncomplicated cases, by no means common, and, when present, I have found it usually confined to the loins, the supra-pubic region, or deeply in the perineum. This perineal pain in well over half my cases was associated with a tender prostate gland as revealed by rectal examination. Urgency of micturition is, too, a common, and often an early symptom, and one has been struck by the intense pain that such patients experience if a sound is passed. I have been guilty of such an operation on occasions through not finding ova on the first examination, and the patient having come from a distance for examination. Knowing of the common incidence of vesical calculus he wishes to be assured of its absence. If he can be told that his condition is schistosomiasis, which is readily included in all the embracing term "harrij bol", he is content to go home, but if a calculus is



found, one has usually not much difficulty in persuading him to remain in hospital for operation.

The foregoing symptoms are, in my experience, those of a moderate or of an early case of infestation with *Schistosoma haematobium*.

In severe cases, sooner or later, cystitis supervenes, and the clinical picture is altered accordingly, and may be aggravated by the development of septic infection, by the formation of calculi, or by an extension of the infection to the ureter and kidneys.

Fatal cases are rare, but the complications just mentioned may result in ureteric dilatation, hydronephrosis, and pyelitis, and are liable to cause a fatal issue. In advanced cases of this kind there is practically no hope of cure. The following notes refer to two fatal cases which came under my care during 1922-1923: under this treatment, but otherwise the patient's

(1) Thawa ibn Abbas, aged 50 years, a resident of a village near Shatrah (River Hai). He was admitted to the New General Hospital, Baghdad, on 1st September 1922, complaining of external haemorrhoids. The haemorrhoids were excised on 2.9.22, under local anaesthesia, and the patient was transferred to the medical division of the hospital (of which I was Physician) on 14.9.22. On arrival he was very ill, and complained of much pain in the left leg in the distribution of the sciatic nerve. He stated that this condition had been present for 8 months; the patient further stated that for one month there had been irregular though slight fever. He was admitted to hospital at once, and I saw him on admission.

Microscopical examination of the urine showed many pus and red blood corpuscles, but ova of Schistosoma haematobium were only found after the third examination. By naked eye examination, too, the presence of blood and pus was readily noted in the urine, and much albumen was also found to be present.

The patient was given urinary antiseptics and bladder washes of 1-10,000 potassium permanganate. On 20.9.22  $\frac{1}{2}$  grain of tartar emetic in 5 cubic centimetres of saline was given intravenously, but, by this time, the patient's condition had begun to give rise to anxiety as his temperature was swinging, and occasional rigors were observed. On 22.9.22 a further injection of  $\frac{1}{2}$  grain of tartar emetic was given. On 24.9.22, 1 grain, on 26.9.22,  $1\frac{1}{2}$  grains, and the latter dose was repeated on alternate days for 6 doses. Blood vanished from the urine under this treatment, but otherwise the patient's condition steadily declined, and he died on 10.10.22, after 24 hours unconsciousness. The relatives refused a post-mortem examination.

Cultures from the urine showed the presence of two organisms.-

(a) B. Proteus, and

(b) B. Pyocyaneus

(2) Ahmed ibn Aboud Ali, aged 26 years, an Egyptian on pilgrimage to Hajaf, was found stuporosed in a Railway carriage at Baghdad West Station, on 29.10.23, and there was such an offensive odour associated with him that no other passengers would enter his carriage. He was admitted to hospital at once, and I saw him on admission.

The patient could be roused sufficiently to state that he was in great pain, and had not passed urine for three days. I found the bladder much distended, and drops of urine with a stinking odour were issuing from the urethra.

There was a hard circular swelling about the size of a small bean in the centre of the penile portion of the urethra, and I cut down on this at once, removing a rough phosphatic calculus, and thereby letting off the urine which was intensely foul. As the man was in a dangerous condition and stuporosed, I employed no anesthetic for the operation. It was impossible to put this patient in a ward with others owing to his odour; I have never experienced as foul an odour as was given by this man's urine.

The patient became comatose, and he finally died on 5.11.23.

I performed a post-mortem examination, and found the bladder gangrenous, and containing a large slough of mucous membrane. Both kidneys showed marked pyonephrosis, and both ureters were semi-gangrenous, and dilated to the size of the small intestine. In the right ureter were two impacted ureteral calculi the size of a bantam's egg. One of the calculi had ulcerated half way through the wall of the ureter.

This patient cannot actually be considered an 'Iraq case as he was presumably infested in Egypt some years earlier, but as he came under one's notice here I feel justified in making reference to him in order to demonstrate the extensive pathological findings which



may be found in fatal cases of schistosomiasis. In severe cases are relatively rare in Iraq. Re-infestation does not appear to be nearly as common as in Egypt, but considering the much denser population in Egypt the explanation of this phenomenon is, I think, evident. On the Euphrates, it is particularly common. In a Papillomata of the bladder occur occasionally as sequelae in Iraq, and malignant vesical disease, too, is by no means a rarity. The largest number of operations During 1922, there were five cases of inoperable carcinoma of the bladder in the wards of the New General Hospital, Baghdad, and the age and place of residence of these cases was as follows:- and a quarter was

(a) Mansoor ibn Ashoor, aged 60 years, a resident of Mahmudiyah (Tigris).

(b) Moosa ibn Hewavel, aged 28 years - from Suk-esh-Suyuth (below Najaf - Euphrates).

(c) Abood ibn Abdulla, aged 35 years, from Mahmudiyah (Tigris).

(d) Rachid ibn Saghir, aged 32 years, from Hai, a village on the river of that name. the urines of

(e) Syed Mohammed ibn Syeed Ali, aged 28 years, from Shinafiyah (Euphrates).

It may be contrary to generally accepted views, but the most striking feature of these cases is, I think, I believe that in no small percentage of cases spontaneous recovery occurs through the natural death of the may be met with. All the patients were from the most common parasites.

infested districts in the country, though in no case

I have come to this conclusion owing to the number were ova of *Schistosoma haematobium* observed, so that of patients one has had in whom a previous history of the cause of these tumours is a matter of conjecture haematuria and "harrij bol" was present, but who, at only.

the time of examination, were symptomless, and ova could

On two occasions, in Hillah Civil Hospital, I operated not be found even after repeated examinations of centrifuged urine. If this conclusion is correct, the absence

and found in each case a large papilloma. A sound had in each case been passed, and the sensation of a stone had been obtained by the large amount of phosphatic gravel that was entangled in the proliferations of the tumour. Vesical calculus is a common result of infestation, and, on the Euphrates, it is particularly common. In a report I made in 1920 regarding medical work at Hillah during the year, and with reference to vesical calculus, I wrote "By far the largest number of operations performed during the year have been for this condition; and in one case a stone, roughly circular, weighing twelve ounces, and measuring approximately three and a half inches by three and a quarter was removed. This stone I sent to the Pathological Museum of Edinburgh University together with a number of smaller ones."

In heavily infested children, it is not uncommon to find a stone of over an inch in diameter present, and I found ova of *Schistosoma haematobium* in the urines of over 50% of these cases.

It may <sup>be</sup> contrary to generally accepted views, but I believe that in no small percentage of cases spontaneous recovery occurs, through the natural death of the causal parasites.

I have come to this conclusion owing to the number of patients one has had in whom a previous history of haematuria and "harrij bol" was present, but who, at the time of examination, were symptomless, and ova could not be found even after repeated examinations of centrifuged urine. If this conclusion is correct, the absence

of ova in so many cases of vesical calculus, and in all the cases referred to of malignant disease of the bladder, may be readily explained. This, however, in the bladder itself in the course of the disease may show alteration in the direction of dilatation, hypertrophy, or contraction. My experience in 'Iraq suggests that the two latter are the commonest of these, and a combination of them very common. In some of the cases on which I performed operation for vesical calculus the bladder was two, three, and even four times its normal thickness, and was readily palpable as a solid mass above the pubes, from the Euphrates districts, and I think Schistosomiasis of the male urethra does not suggest itself as being nearly as common in 'Iraq as in Egypt, and I have seen very few cases in which the deep urethra has been involved; I have noted a few cases of perineal fistulae from this cause, however. With regard to the female urethra the same holds good. Fistulae, resulting in peri-urethral abscesses, are occasionally met with, and I have seen four cases of pseudo-elephantiasis of the penis associated with this condition. Rectal symptoms are by no means uncommon, and I am of opinion that such symptoms in infestation with *Schistosoma haematobium* are much commoner than is generally supposed. In the article on "Rectal papillomata in *Schistosoma haematobium* infestation", published in the British Medical Journal of June 1923, Dr. Mills and I referred to three cases of this nature occurring in 'Iraq, and



in all of them typical terminally spined ova were found in the faeces, and in the papillomata on section. Earlier reference has been made to this, however, in discussing the pathology of the infestation.

Dysentery due to this parasite is by no means uncommon, and it is usually characterised by the presence of both blood and mucus, the former dark in colour, free, and much in excess of the latter.

The demonstration of ova in the faeces is naturally a much more difficult matter than is a similar demonstration in the urine, but I was able to find ova in 5% of my urinary cases from the Euphrates districts, and I think that this percentage is possibly lower than the actual incidence.

In the dysenteric-like stool the finding of ova is usually a simple matter; it is when the stool is formed that difficulty occurs, and many examinations may be needed before a positive finding is made, and many more still before a negative result can be given.

In these cases some ulceration of the lower bowel is frequently present within reach of the finger, and marked tenderness on digital examination is usually complained of at the level of the prostate gland. Pulmonary symptoms, cough with terminally spined ova present in the sputum, have been recorded by some observers, but I have not had a case of this nature so far in Iraq.

The most characteristic feature of the blood is the presence of an eosinophil leucocytosis, which is more pronounced in early cases, but may be present to

some extent during the whole course of the disease. In advanced cases, and in cases complicated by a super-added septic infestation, I have found that eosinophilia tends to diminish, and a neutrophil polymorpho-nuclear leucocytosis to develop in its place. This eosinophilia is apparently caused by some toxin, excreted either by the parasites or their ova, stimulating the leucoblastic tissue of the bone marrow to excessive production of eosinophil leucocytes.

An analysis of a series of 28 cases, some recently infested, and others of a more chronic nature, but all of them uncomplicated cases, gives the following average total and differential blood count for cases observed by me in 'Iraq:

Total red blood corpuscles per cubic millimetre: 4,782,000  
 Haemoglobin: 85%  
 Haemoglobin index: .88

Total white cells per cubic millimetre: 9,600 cases  
 Differential count: were as follows:-  
 Polymorpho-nuclear leucocytes: 55.1%  
 Large mononuclear leucocytes: 10.9%  
 Lymphocytes: 23.2%  
 Eosinophil leucocytes: 10.8%

These figures show two interesting differences from the blood counts recorded by Fairley in Egypt, the most striking being a lesser degree of eosinophilia in 'Iraq cases. Fairley's average for 3 cases was 18.6%

There can be no question that infestation with *Schistosoma haematobium* is in 'Iraq milder than in Egypt; I suggest through less risks of hyper-infestation the differential diagnosis of infestation with

in the sparse population of this country, and as of eosinophilic increase is due to leucoblastic response to toxin, and Iraq cases have presumably less circulating toxin, and so show a lower percentage of eosinophilia. The higher percentage of polymorpho-nuclear leucocytes in Iraq cases is, I think, mainly dependent on the decrease in the eosinophil percentage; with these two exceptions the differential counts of the two countries show little variation. The degree of anemia, except in very highly infested cases, is very slight, as reference to the above figures show. In chronic and complicated cases, the blood picture may show alteration through the supervention of sepsis, when a secondary anaemia is usually to be observed. In the latter type of case, too, the eosinophil percentage tends to diminish, and the polymorpho-nuclear percentage to increase.

The variations in the eosinophilia in the 28 cases to which I have just referred were as follows :-

EOSINOPHILS.

- (a) Up to 10% .. 14
- (b) 10% - 20% .. 9
- (c) 20% - 30% .. 4
- (d) 40% - 50% .. 1
- (e) above 50% .. Nil

These figures again vary from Egyptian ones where the highest percentage occurs between 10% and 20%.

My female cases have all been uncomplicated, and much milder in type than male infestations.

DIFFERENTIAL DIAGNOSIS.

The differential diagnosis of infestation with

Schistosoma haematobium embraces a large number of urinary conditions, but the finding of terminally spined ova is conclusive. One must always be prepared for the co-existence of another urinary disease, and to consider signs and symptoms very carefully so that the second disease is not overlooked.

In early states, eosinophilia is suggestive, and differentiated patients presenting urinary symptoms from Fairley's complement deviation reaction may clinch the diagnosis. I have known the fever of the early stages mistaken for one of the enteric group of fevers, for which were not suffering from schistosomiasis. The miliary tuberculosis, chronic malaria, and even liver abscess, and the differential diagnosis in early cases taken for schistosomiasis in Iraq is vesical calculus, is sometimes one of considerable difficulty.

From the enteric group, the slower pulse of the latter, the type of fever, abdominal pain, blood culture, vesical calculi, in a proportion of approximately 3 to 1, and the Widal test, distinction is usually fairly easy, though the two conditions may of course co-exist.

The signs and symptoms of bladder calculus are very similar to those of schistosomiasis, but with absence of other signs. There is a mononuclear increase in both chronic malaria and infestation with Schistosoma haematobium, but the presence of the malarial parasite in blood smears, together with splenomegaly, make differentiation easy as a rule. The presence of eosinophil leucocytes in blood smears, apart from the demonstration of ova in the urine, is strongly suggestive of schistosomiasis.

The higher leucocytosis, sweats, liver enlargement, and tenderness of hepatic abscess do not usually present real difficulty in diagnosis. Renal calculus, too, is common in Iraq and may present difficulties in differential diagnosis, but the occurrence of renal colic, together with renal cells in the urine, usually suffices to distinguish between the two conditions.

After haematuria and "harrij bol" have once developed, a number of other urinary diseases are liable to be confused, and, among natives, the mode of livelihood, and the district in which they live, are very

I have met with four cases of acute nephritis



diagnosed as schistosomiasis, but careful examination helpful aids.

One is very apt to conclude that all cases of the former disease, did not long leave the diagnosis haematuria or painful micturition in an infested district in doubt.

must be infested with *Schistosoma haematobium*, and

a glance at the figures of incidence already given are, usually present little difficulty if cystoscopic examination is employed, but, as already noted, tumour formation is in many cases but a sequel to schistosomiasis, those who were symptomless, and it will be seen that

gonorrhoeal cystitis usually supplies a history of out of the former cases there remained a large number previous gonorrhoea and gonococci may be demonstrated in which were not suffering from schistosomiasis. The stained films of the pus in the urinary deposit, commonest of these urinary diseases likely to be mis-

taken for schistosomiasis in 'Iraq is vesical calculus. the demonstration of bacilli is to be relied upon for

As already noted the two conditions are commonly diagnosis.

associated, but in a large number of my cases of

The passage of crystals of calcium oxalate in the vesical calculi, in a proportion of approximately 3 to 1, urine is extremely common, particularly in the agri-

no ova were demonstrable in the urine. cultural districts of 'Iraq, and, in my experience,

The signs and symptoms of bladder calculus are apart from schistosomiasis, it is the commonest cause very similar to those of schistosomiasis, but with of urinary symptoms among the fellahs.

XRay and microscopic examination, and the passage of

The probable origin of this is, I think, a combination of poor dietary and of digestive disturbances, difficulty. Further, the presence of eosinophil

The dietary of the town dweller is varied, but the poor leucocytes in blood smears, apart from the demonstration agricultural labourer relies mainly on bread, milk, of ova in the urine, is strongly suggestive of vegetables, fruits, and tea, articles of diet in which schistosomiasis.

oxalic acid is most commonly found, for his nourishment.

Renal calculus, too, is common in 'Iraq, and may

Digestive disturbances, too, add to the deposition present difficulties in differential diagnosis, but the

of oxalate of lime in the urine and dyspepsia is very occurrence of renal colic, together with renal cells in

prevalent, both in town and country, in 'Iraq. Consti-

the urine, usually suffices to distinguish between the pation is almost a national characteristic, and intestinal

two conditions. helminths common; both of these are very potent causes

I have met with four cases of acute nephritis

diagnosed as schistosomiasis, but careful examination of the urine, together with other characteristic features of the former disease, did not long leave the diagnosis in doubt. The characteristic small octahedral colourless Papilloma and malignant disease of the bladder usually present little difficulty if cystoscopic examination is employed, but, as already noted, tumour formation is in many cases but a sequel to schistosomiasis. The Gonorrheal cystitis usually supplies a history of previous gonorrhea, and gonococci may be demonstrated in stained films of the pus in the urinary deposit. In the urine. In tuberculous cystitis, cystoscopic examination, and the demonstration of bacilli is to be relied upon for diagnosis. namely, painful and frequent micturition. The passage of crystals of calcium oxalate in the urine is extremely common, particularly in the agricultural districts of 'Iraq, and, in my experience, apart from schistosomiasis, it is the commonest cause of urinary symptoms among the fellaheen. The probable origin of this is, I think, a combination of poor dietary, and of digestive disturbances. The dietary of the town dweller is varied, but the poor agricultural labourer relies mainly on bread, milk, vegetables, fruits, and tea, articles of diet in which oxalic acid is most commonly found, for his nourishment. Digestive disturbances, too, add to the deposition of oxalate of lime in the urine, and dyspepsia is very prevalent, both in town and country, in 'Iraq. Constipation is almost a national characteristic, and intestinal helminths common; both of these are very potent causes

of digestive upset.

Oxaluria may, and often does, co-exist with schistosomiasis. The usual form of calcium oxalate in 'Iraq is the characteristic small octahedral colourless crystals; the dumb-bell form is, however, occasionally met with.

~~Pyelitis~~ Pyelitis and pyelo-nephritis, do not normally present much difficulty in the differential diagnosis. The general condition of the patient, the fever, pain and tenderness over the affected kidney, and the presence of pus, albumen, blood, and tube casts, in the urine, usually form a very clear clinical picture.

An enlarged prostate may cause symptoms suggesting schistosomiasis, namely, painful and frequent micturition, but such a condition is readily excluded by rectal examination, and the age of the patient is often very suggestive.

Finally, diabetes mellitus must be mentioned. I have had three cases sent to me for treatment complaining of frequency of micturition associated with some pain, in which the local practitioner had not examined the urine, and so had overlooked the presence of glycosuria.

#### PROGNOSIS.

Prognosis in this infestation is not always a simple matter; the cause may possibly <sup>be</sup> removed without difficulty, but there still remains the damage which has already occurred. Prognosis is very dependent on the chronicity of the condition, and the degree of infestation.

Undoubtedly there are cases of spontaneous cure, and, I think, these cases are more frequent than is generally believed.

Spontaneous cure cannot, however, be relied on in prognosis as cases have been known of infested persons, in whom re-infestation could be definitely excluded, passing live ova 20 years after the onset of the disease; pensions paid to our soldiers after the South African War afford examples of this.

Another factor in prognosis is the area in which an infested person lives; there is no doubt that the greater the incidence in any locality the greater is the probability of severe infestations occurring.

Since the introduction of Christopheron's method of treatment by tartar emetic, the prognosis in schistosomiasis has become much more favourable, and an uncomplicated case becomes that of a remedial inflammation of the bladder. The disease is not in itself fatal, but calculus formation, the occurrence of malignant disease, or renal affections, may arise, and the prognosis then becomes correspondingly grave.

Apart from its local manifestations, there are two general effects of infestation which may occur, namely, anaemia and debility. These conditions vary much in degree in different cases; usually, however, the degree of anaemia is slight. The debility of schistosomiasis varies greatly, but is nevertheless very important, and, in a country such as 'Iraq, crying for development, but without a sufficiency of population to accomplish it, it becomes a big economic problem. In children



schistosomiasis commonly results in both physical and mental backwardness; this has been much impressed on one on visits paid to the government school in Hillah.

#### SPECIFIC TREATMENT.

Until Christopherson introduced the method of intravenous injection of a solution of tartar emetic, the treatment of schistosomiasis was only palliative.

Much has been written regarding this method of treatment and I have used it in 'Iraq in the majority of my cases.

After long experience there are three drugs on which I still place reliance in the treatment of schistosomiasis namely :-

1. Antimonium Tartaratum (Tartar emetic).
2. Emetine Hydrochloride.
3. Antimonii et Sodii Tartaras.

#### 1. ANTIMONIUM TARTARATUM.

I consider Antimonium Tartaratum to be much more efficacious than either of the other drugs, and I employ it almost invariably now unless the patient shows intolerance.

There can be no doubt that in the majority of cases cure is effected by this drug, but there remain a definite proportion of cases in which a total of 30 grains of the drug seems insufficient to make a permanent cure.

In a series of 25 cases in Baghdad, among Jews infested on a pilgrimage to Kifl, in whom re-infestation could be excluded, in 5 of these cases, that is, in a

percentage of 20, live ova were again demonstrable in the urine three months after the end of the treatment; 30 grains of the drug had been administered intravenously in each, and Christopherson's directions closely followed.

Adult male arabs usually possess prominent veins, and intravenous injection is a very easy matter in them.

I have not found Christopherson's suggestion of maintaining a stock solution of tartar emetic in a strength of  $1\frac{1}{2}$  grain to 1 cc of distilled water, and diluting with normal saline prior to injection, quite satisfactory, and I am now in the habit of making up my stock solution fresh with saline solution, as I find that in this way toxic symptoms are less liable to occur; in a stock solution fungi are liable to grow.

For a full course of 30 grains, 27 days are required, and allowing 1 day for examination before, and two or three days' rest at the end of the course, a month becomes the minimal time for an adult to be under treatment.

With children I usually start with  $\frac{1}{4}$  grain, increasing on alternate days by  $\frac{1}{4}$  grain to a maximum of 1 or  $1\frac{1}{2}$  grain, according to age. The treatment in children is completed in a week less, as I do not normally employ more than a total of from 10 to 12 grains. Great care has always to be taken that none of the solution escapes into the tissues about the vein, or sloughing or abscess formation is almost certain to occur.

Injection is better not given for 3 hours or so after food, and half an hour in a recumbent position.

afterwards is indicated. In the Royal Hospital, Baghdad, my injection time, and that of the mid-day meal, often clashed, and a hungry patient would occasionally manage to obtain part of another patient's food. In these cases injection frequently revealed the misdemeanour by speedy vomiting.

As far as possible, cases have been kept in hospital during their course of treatment, but only in a few cases were patients willing to stay for a month. As soon as haematuria ceases or "harrij bol" disappears, patients, as a rule, insist on returning home, and this has been a great difficulty in treatment.

The arab wishes for immediate cure; he soon wearies of treatment, and to receive treatment when his symptoms have vanished is utterly beyond his comprehension. I am speaking of the uneducated agriculturalist, but these have comprised an overwhelming majority of my patients.

Before injection I have found it advisable to dip the needle, after filling with tartar emetic solution, into sterile water. In my earlier cases, in which this precaution was not observed, patients commonly complained of pain at the site of injection, but following the removal of any traces of tartar emetic in this way, I have had no such complaints.

In the vast majority of my cases coughing has developed within a minute or two of the injection, and some giddiness has been complained of; these toxic effects are transient, however, and I have had no alarming symptoms following. It is quite common for a slight rise of temperature to occur within a few hours, and

I have commonly noted pains in the shoulder joints. Vomiting does not usually occur in my experience, unless the patient has partaken of food during the previous hour or two.

Day has found that three courses of treatment of one week each with an interval of a week between courses is very satisfactory, and this has been adopted as a routine method at the Kasr-el-Ainy Hospital in Egypt. So far I have not tried this method, and at present one cannot expect an 'Iraq fellah to attend hospital, either as an in-door or out-door patient, for 6 weeks, and so one's aim has been, and still is, to inject as much of the drug as one can in the shortest possible space of time.

Another factor presents itself in one's difficulties; it is only during the winter months, after the crops have been gathered in, and before re-sowing commences, that the fellah is out of work and so is available for treatment. The fellah lives a hand-to-mouth existence, and when work is available he must take it or starve. This is a big factor in treatment in 'Iraq, and seems almost unsurmountable under present conditions.

If toxic symptoms are at all marked, I invariably give a smaller dose at the next injection, and this has usually sufficed to produce tolerance to an increased dose two days later. In a few cases colicky pains have followed injection, but they are not, in my experience, common.

The results achieved by tartar emetic are probably in the main due to its cumulative action, as the drug



continues to be excreted for 2 or 3 weeks following completion of a full course. Its immediate effects are cessation of haematuria and of egg production, and death of the miracidia of those already in the tissues. The final result is death of the worms themselves, but they are not in my experience as readily disposed of as some accounts of this treatment have suggested, and I do <sup>not</sup> think my percentage of recurrence, namely 20%, is too high an estimate to accept as a general one.

#### EMETINE HYDROCHLORIDE.

This was the first drug I employed for this condition in 'Iraq, and I have found it very useful. In children, or in others in whom intolerance to tartar emetic is observed, I still occasionally employ this drug, exhibiting it by intramuscular injection if the intravenous route is for any reason unavailable.

For adults, I employ an initial dose of 1 grain, increasing the dose every second day by half a grain to a maximum of 3 grains, dissolved in 2 cc of water. At first I employed the drug subcutaneously, in daily doses of 1 grain for a fortnight, and repeated the course at an interval of one week, but, although this usually sufficed to cause blood to disappear rapidly, in a little more than 20% of cases so treated ova were still demonstrable at the end of the first fortnight, and the percentage was only slightly improved at the end of the second course.

With larger doses, much more satisfactory results were obtained. A full course of 28 grains was given in 21 days. This is speedier than a full course of tartar

emetic, but there are two serious drawbacks. It is not as certain a remedy as tartar emetic, and I have found its efficiency only about one sixth of that drug. Further, emetine is very costly; it is approximately 150 times more expensive than tartar emetic, and the cost of each dose in 'Iraq is nearly one rupee; this is a most important consideration where large number of injections are being given.

With children I do not often exceed a maximum of 1 grain at each injection, and it is my custom to give them a total of about 12 grains in a course.

Toxic symptoms, such as tachycardia, are not usually noted in these doses.

#### SODII ET AMMONII TARTARAS.

My experience with this drug, as an alternative to tartar emetic, has been confined to the Antimony Tartrate Compound of Burroughs, Wellcome & Co. This preparation is supplied in two strengths, namely, Soloid Antimony Tartrate Compound No.1, which contains in each tabloid 10 grains of sodium antimony tartrate and  $5\frac{1}{2}$  grains of sodium chloride, and Soloid Antimony Tartrate Compound No.2, which contains in each tabloid 1 grain of sodium antimony tartrate, and  $\frac{11}{20}$  grain of sodium chloride.

Prior to use each tabloid of preparation No.1 requires to be dissolved in 50 cc of distilled water and boiled, while each tabloid of preparation No.2 requires 4 cc of water.

Preparation No.1 has been used by me almost exclusively in hospital, and preparation No.2 in private

work.

Each 2 cc of solution contains  $\frac{1}{2}$  grain of sodium antimony tartrate, and toxic symptoms are certainly less common with this drug than with tartar emetic.

My results have been good, given on alternate days and in similar doses as tartar emetic. But, while being less toxic to man, the drug appears to be also less toxic to the helminths, and so one's results have not been as satisfactory. The risks of using tartar emetic are, I think, so slight that I consider the latter drug in every way preferable, except in cases of intolerance being shown to it.

#### SYMPTOMATIC TREATMENT.

The early haematuria can usually be controlled by extract of male fern in 10 minim doses twice or thrice daily. Dr. F.M. Halley, of my own service, who has been in charge of a travelling dispensary in this country, has considerable experience of this drug, and has repeatedly advocated its use to me. I must say that in cases in which I have used it there has usually been an almost immediate cessation of haematuria.

While bladder irritability is present hyoscyamus is definitely indicated, and in many cases causes marked amelioration of the distressing "harrij bol". As a routine medicine in these cases, I have found the following excellent in cases in which the urine is acid :-

$\mathcal{R}_x$	Urotropin	grs. 10
	Potassii Citratis	grs. 20
	Tr. Hyoscyami	℥. 20
	Aq. Chloroformi	ad. 1 oz.
Sig/	1 oz t.d.s. p.c.	

and in cases of alkaline urine I usually prescribe

Rx	Urotropin	grs. 10
	Acid Sodii Phosphat.	grs. 20
	Tr. Hyoscyami	m. 20
	Aq. Chloroformi	ad. 1 oz.
Sig/	1 oz. t.d.s. p.c.	

Diet naturally varies with the severity of the infestation; in mild cases I allow a full dietary, but in severer cases meat is not allowed, and, in more advanced cases, a milk diet is enforced, with additions such as arrowroot and other cereal foods.

In cases in which the dysuria is very marked, morphia suppositories have proved to be an excellent means of alleviating the spasm and pain.

I always advise patients to drink copiously of water, or other bland fluids, such as barley water, and in patients who can afford them, and in whom the urine is acid, I have found the natural alkaline mineral waters, such as Contrexeville and Vichy, very useful.

Anaemia is not usually very severe, but in a number of cases I have exhibited the scale preparations of iron with marked benefit.

When cystitis is pronounced, I have been in the habit of washing out the bladder with a 1-10,000 solution of potassium permanganate, and, in a number of cases, the benefit from such treatment has been very striking.

The surgical complications such as calculus and fistula require treatment on usual surgical lines, though it is advisable, whenever practicable, to postpone surgical measures until a course of tartar emetic or one of the other drugs considered under specific treatment has been given.



## PROPHYLAXIS.

In 'Iraq the problem of the prophylaxis of this disease has not as yet been attempted on any large scale, mainly owing to financial stringency. The importance of personal hygiene can hardly be exaggerated, but unfortunately it is only at present practised by Europeans and by the better educated local population. Personal hygiene can certainly prevent infestation.

Sportsmen in 'Iraq, while out snipe and duck shooting, should wear high rubber waders as a prophylactic measure, though, fortunately, the shooting season is restricted to the colder months of the year, when less liability to infestation occurs on account of diminution of snail fauna.

Fishing, also, is associated with some risk, and the handling of freshly caught fish from an infested canal may result in infestation. The risk of infestation in this way from the main rivers is very small.

The wearing of boots and shoes is an important prophylactic measure, and, as education advances, the number of foot-clad Iraqis is steadily increasing.

Bathing in irrigation canals or ponds is very risky, and it is probably the usual means of infestation in 'Iraq. That the main rivers are practically free from risk in this connection is demonstrated by the number of Europeans who bathe in the Tigris near Baghdad, both above and below the city, during the summer months, and I think to date without a single case of infestation having occurred in this way.

By drawing water for ablution purposes from a contaminated supply the hands may prove a site of infestation. With regard to water, sterilisation by boiling is, I think, the best method of killing cercariae, especially in drinking water. For water used for ablution purposes cresol or lysol (in a strength of 1: 10,000) are efficient and speedy cercariacides.

Simple storage of water for from 24-36 hours suffices to kill all cercariae, and may be relied upon when other methods are not practicable, or water may be very conveniently sterilised by the addition of sodium bisulphate (sodii sulphas acidus), in the form of tabloids, to the water. These are usually sold in tabloids of  $7\frac{1}{2}$  or 8 grains each, and two of these added to a quart of water cause the almost immediate death of any cercariae. The only objection to the use of sodium bisulphate in my experience is that it is liable to cause looseness of the bowels, particularly when constantly employed. Patented tablets known as "anti-typhoid tablets", which contain  $7\frac{1}{2}$  grains of sodium bisulphate in each, are a decided improvement on the plain drug, as they produce a palatable and slightly acid taste to the water.

In the towns of 'Iraq where there is a controlled water supply, sedimentation and chlorination of the water are invariably practised. Chlorination does not, as usually practised (giving a dilution of 1 in 1,000,000), kill cercariae. 24 hours sedimentation is needed for the muddy water of the Tigris and Euphrates to clarify prior to chlorination, and this frees the water of live

cercariae, or if a few still remain after the process of sedimentation and chlorination, they have still to face the ordeal of being pumped into high service tanks, and stored there until the water is drawn off through pipes to household taps.

In connection with purification of water for bathing purposes, Lt. Col. Hamerton conducted a series of experiments with trematode larvae at the Central Laboratory, Baghdad, and, though not those of *Schistosoma haematobium*, they belonged to an allied species found in a snail at Hinaidi. Death of the cercariae occurred as follows with the following dilutions of cresol employed :-

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(a) 1 in 10,000 (1 oz per c.ft.)	3 Minutes
(b) 1 in 100,000	10 Minutes
(c) 1 in 200,000	12 Minutes
(d) 1 in 500,000	15 Minutes
(e) 1 in 1,000,000	4 hours.

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These results led Lt. Col. Hamerton to experiment with Cresol in the water channels at the Hinaidi Cantonment and he reported "Cresol having a phenol co-efficient of 13 ? was mixed with water at the river-side pumping station, and was delivered into the channels in a dilution of one of cresol to one million parts of water as recommended by various authorities for the destruction of mosquito larvae, which, as was confirmed in the Central Laboratory, will not live for more than 48 hours in this solution kept in a glass jar".

"After some months trial in the field there appeared

to be no diminution of mosquito larvae in the water channels, and many minute forms of pond life flourished in the cresolised water". "The efficacy of the larvicide was doubted, and subsequent investigation proved that in the peculiar soil of this country the bulk of the cresol added to the irrigation water combined with the silica, to form aluminate of phenol, an inert compound". This experiment therefore is an instance of how false a sense of security might be engendered by failing to recognise the limitation of a laboratory experiment." Lt.Col. Hamerton reported further: "The ponds and channels have been cleared out. The rate of water flow has been accelerated, and every 3 months the water is cut off and the channels left dry for 14 days." "These measures have undoubtedly caused a great reduction in the snail population of the Cantonment, and, as far as is known at present, there is no case of Bilharziasis in which infestation can be traced to Hinaidi Cantonment".

This was written in September, 1922, but in the spring of 1924, a few cases occurred in Hinaidi Cantonment among British troops, and under such circumstances as to suggest without much doubt a local focus of infestation there. Infestation, however, could be traced to a bathing pool erected during the summer months of the previous year.

Apart from the purification of water supplied, the prevention of contamination of water by urine or faeces is no less important. When considering disposal of excreta as a factor in helminthis spread, it was remarked how fond the agricultural people are of defaecating or



urinating into water channels, and that the water from the same channels is often the source of the water supply of the neighbouring households. How hard is prophylaxis with local habits such as these! Education is the main hope in this direction.

Defaecation is usually followed by ablution, and contact with infested water in this way is a possible source of infestation.

With habits such as these favouring the spread of schistosomiasis, 'Iraq is fortunate indeed in having a scattered population; it is only about 20% as dense as that of Egypt, and density of population in an infested area increases the risk of contamination of the water supply, and so of the incidence of the disease.

Emigration and immigration are important owing to the risk of carrying schistosomiasis into new districts or new countries. Where there is controlled water supply, and a satisfactory sewage system, schistosomiasis cannot spread, and the ideal way of treating infested new arrivals is to prevent them from living in an area where it is possible for them to contaminate the water supply. This is easier said than done, however.

A routine examination of arrivals from an infested district, or from another infested country, would be of great value and quarantine might be enforced, but it is not practicable, in this generation at least, in 'Iraq.

The prophylaxis of schistosomiasis in 'Iraq is a very big problem for the future, and it may well go hand in hand with the prophylaxis of ankylostomiasis to be considered later. The time has not yet come for



PERSIAN FRONTIER.  
Mountain Zone.

a successful campaign, however; the country is poor, the people as a whole are indifferent, and the very simplest principles of hygiene are neither appreciated, understood, or accepted, by over 95% of the population.

Preventive medicine in 'Iraq must proceed hand in hand with education, and the civilisation of the country is at present centuries behind our own. United action by the departments of Health, Irrigation, and Education, will be needed before schistosomiasis in 'Iraq can be checked, and eradicated.

When it becomes possible for an extensive campaign against schistosomiasis to be carried out in 'Iraq, most reliance will have to be placed on the destruction of the snail intermediate host, for once the host is extinct the disease will speedily vanish.

In Egypt the possibility of reducing the mollusc~~an~~ fauna by means of ducks, and other wild fowls has been considered, but, in spite of the enormous flocks of wild fowl which frequent 'Iraq during the winter months, I am convinced that little material reduction in the snail fauna can be expected in this way, more especially as during the winter months such fauna is scarce.

Most reliance will have to be placed on a scheme for destroying the snail hosts by dessication, and this is no easy matter with irrigation as at present employed.

In order to ensure sufficient dessication, canals would require to be closed for at least fifteen days, and this is only possible by the construction of regulators at the head of canals, and a system of dual channels whereby each can be shut off in turn from its water

supply.

This scheme is practicable, but costly, and financial assistance from the government would be essential; this, at the present time, with a bankrupt exchequer, is not easily accomplished, but the problem cannot be put aside for long if the C<sub>3</sub> standard of health which at present exists in infested areas is to be raised to a standard of greater economic efficiency.

This scheme, however, is only applicable in areas where irrigation can be controlled, and does not include the flood lands wherein, unfortunately, schistosomiasis is peculiarly prevalent.

No system of regulators can destroy the molluscan fauna in such regions, and only personal hygiene, and the control of water supply, can check the spread of the disease in such districts.

As already emphasised, the problem of checking the incidence of schistosomiasis depends on the concerted efforts of the Departments of Education, Irrigation, and Health. In this way only can medical treatment be successful, re-infestation prevented, and the rising generation spared from the toll of ill-health exacted from previous generations.



## SECTION IX.

### THE PLATYHELMINTHIC DISEASES OF MAN IN

#### 'IRAQ (Continued).

#### B. CESTODE INFESTATIONS.

The class Cestoda, or "Tapeworms", consists of two orders, Pseudophyllidea and Cyclophyllidea; the order Pseudophyllidea, which has only one family, the Dibothriocephalidae, is not, however, represented among the parasitic helminths of 'Iraq.

The order Cyclophyllidea consists of four families, readily differentiated as follows :-

##### A. HYMENOLEPINIDAE.

One row of hooks on rostellum, no hooks in suckers, genital pores unilateral. Uterus sac-like.

##### B. DAVAINIIDAE

Two rows of hooks on rostellum, hooks in suckers, genital pores unilateral, uterus with egg nests.

##### C. TAENIIDAE.

Two rows of hooks on rostellum, hooks in suckers, genital pores irregularly alternating, uterus branching.

##### D. DIPYLIDINIDAE.

Four or more hooks on rostellum, no hooks in

suckers, genitalia and pores bilateral, uterus with egg nests.

The families Hymenolepinidae, Taeniidae, and Dipylidinidae, are all represented in the parasitic fauna of 'Iraq, as follows :-

- (a) Hymenolepinidae, by *Hymenolepis nana*.
- (b) Taeniidae, by *Taenia solium*, *Taenia saginata*, and *Taenia echinococcus*.
- (d) Dipylidinidae, by *Dipylidium caninum*.

I propose now to consider the infestations of these parasites in 'Iraq in turn, commencing with *Hymenolepis nana*.

#### 1. INFESTATION WITH HYMENOLEPIS NANA.

The rat appears to be both the definitive and the intermediate host of this small tapeworm, though the point has not yet been conclusively proved.

Infestation with this parasite in 'Iraq is, in all probability, much commoner than is at present known, though to date I have only noted 5 cases, and 2 of these were probably imported infestations.

During the late war, the parasite was found in 1 per cent of routine stool examinations of Indian soldiers in 'Iraq, but my three arab cases are the first recorded among the local population. Of my five cases two were Indian clerks employed at the Headquarters of the 'Iraq Railways in Baghdad, and both of them displayed symptoms; these two cases were observed during 1923-24. During my service in Hillah I met with the parasite in arabs on three occasions. Two of the infestations occurred in boys of about 10 years, the

other in a man aged 25 years; all were from the middle Euphrates area.

The great ease with which the ova are overlooked requires emphasis; their smallness and transparency are such that, unless one looks for them with very great care, they may readily escape detection.

These three cases among natives of the country are of great interest as rats abound in towns and villages, and the climate of the country is favourable to the growth of the parasite.

With regard to the origin of the infestation in 'Iraq, as these are the first recorded cases I can say nothing, but should the parasite not have been included in the helminthic fauna before the war it undoubtedly had opportunities of increase then, when so many Indians and Egyptians were introduced into the country.

The fact, however, that 'Iraq has for many decades been a great pilgrim centre for Shiahhs suggests that the parasite must have entered the country before its military occupation by us.

The symptoms and signs presented by my Indian patients were in the main identical, namely, irregular colicky pains, persistent diarrhoea, debility, halitosis, and furred tongue. One of the patients was afreble, the other had a low fever, and, in addition, he complained of constant headache.

In only the adult arab case were signs of symptoms present. The patient was a resident of Hillah, and gave a six months' history of frequent abdominal pains, and attacks of diarrhoea alternating with constipation.

In the case of the two boys ova were found quite accidentally; they were both suffering from schistosomiasis (*Schistosoma haematobium*), and it was while searching their stools for possible ova that the ova of *Hymenolepis nana* were found. One of the boys was from Kifl, the other from Diwanayah, and both were town dwellers.

In none of my cases were serious nervous manifestations noted; headache was the only nervous symptom observed, and that in only one case.

In each of my cases I employed extract of male fern as an anthelmintic, and immediate cessation of symptoms resulted.

Prophylaxis is somewhat difficult as the life history of the parasite is not certain, but general sanitary measures and rat destruction are unquestionably indicated.

## 2. INFESTATION WITH TAENIA SAGINATA.

This, the "beef tapeworm", is found in all parts of the world where ox flesh is eaten, and the commonest form of taeniasis in 'Iraq results from this cestode.

The distribution in 'Iraq varies somewhat among town dwellers and the rural population, mainly, I think, owing to the latter being more frugal and vegetarian in diet. In the country districts, flesh, particularly ox flesh, is not much eaten, for the fellah is poor, and cannot afford such a delicacy. Mutton, chicken, and fish, are eaten when times are good, but there are a large number among the fellaheen who have hardly ever tasted beef.



In 520 routine stool examinations, performed in Hillah during 1919-1920, I found segments of this parasite present on only 15 occasions, a percentage of 2.8. 80% of these cases were fellaheen, and almost exclusively Mohammedan, and I think this figure may be accepted as an average incidence for the rural population of 'Iraq.

For Hillah town, my stool examinations amounted to 57 in all, and positive findings occurred in 3 of them, a percentage of 5.2.

Among residents of Baghdad, in <sup>1922-</sup>1923, I performed 164 routine stool examinations, and had 7 positive findings, a percentage of 5.4.

My Baghdad figures represent 116 adults and 48 children, who, respectively, gave the following figures:-

T. saginata 1922-1923.	Total examina- tions.	Positive findings.	Percentage.
Adults	116	6	5.1
Children	48	1	2

These percentages show a marked disparity between infestations among adults and children, but are, I think, to be explained by the lesser consumption of flesh by children. Meat of all kinds is not a common article in the local child's dietary, and beef, being more expensive than mutton, is hardly known by the majority of children. Divided into their respective religions my adult figures for Baghdad are as follows :-

T. saginata 1922-1923.	Total examinations.	Positive findings	Percentage.
Adults	-	-	-
(a) Mohammedans	27	1	3.7
(b) Jews.	64	3	4.6
(c) Christians	25	3	12

These numbers are small, but I have no doubt that the christian population, which is more beef loving, invariably shows a higher percentage incidence of infestation than the other two religious classes.

Sex does not seem to impose any special predisposition to infestation, and in my cases the sex incidence was equal.

#### SYMPTOMATOLOGY.

In the majority of my cases the only sign or symptom complained of was the passage of segments of the parasite in the stools, but, in addition, in a number of cases, there was complaint of attacks of colic associated with occasional attacks of diarrhoea.

A few cases complained of segments being passed apart from defaecation, and three of my patients produced segments which had been found in their under-clothing.

I have occasionally observed this parasite as a multiple infestation with *Ascaris lumbricoides*, *Trichuris trichiura*, and *Ankylostoma doudenale*, but this will be further considered in the section relating to multiple infestations.

Derangements of appetite were definite in 20% of my cases, usually taking the form of increase; a minority also complained of irregular attacks of vomiting.

In children, the commonest signs noted were picking at the nose, scratching of the anus, and loss of weight.

Blooding changes in all my cases were marked by their absence, and I only noted eosinophilia in those cases which were also harbouring a second parasite.

My series of cases was singularly free from the nervous phenomena often described, and these symptoms were restricted to my Jewish patients in whom nervous affections tend to be prevalent. Such symptoms were much aggravated by the constant appearance of segments in the stools; giddiness and drowsiness were the commonest nervous symptoms noted.

I have had two cases of this infestation among Europeans, but the greater care taken in choosing meat, and in its preparation, keeps the incidence very low among the European population in 'Iraq.

#### DIAGNOSIS.

Diagnosis has in my cases rested almost entirely on the presence of proglottides in the stools, and only occasionally has confirmation been possible by the demonstration of ova.

Differential diagnosis does not present much difficulty in 'Iraq, as *Taenia solium*, with which *Taenia saginata* may be confounded, is practically non-existent in the indigenous population. The numerous branches springing from the marked median uterine stem, make it easy to differentiate *Taenia saginata* from the lesser branched *Taenia solium*.

## PROGNOSIS &amp; TREATMENT.

Excepting that difficulty may be experienced in removing the head of the parasite, prognosis is good.

The subject of treatment divides itself into three headings, prophylactic, symptomatic, and medical.

The best prophylaxis is undoubtedly the exclusion of ox-flesh from the dietary, but, as this is hardly practicable, one has to fall back on meat inspection, and careful cooking of such food. Earlier in my thesis I have suggested that the underdone meat constituting the "kabab" is a factor of importance in the spread of this form of taeniasis in 'Iraq. Official meat inspection is non-existent except in the three largest towns, and, even in them, it is very sketchily performed. Every mature cysticercus capable of infestation is visible to the naked eye, and, though most likely to be found in the muscles of the heart, tongue, jaw, and diaphragm, isolated cysts may be readily overlooked when situated elsewhere.

From the point of view of personal prophylaxis, too great emphasis cannot be laid on care in roasting or boiling the flesh; if this is carried out properly, there is no risk of infestation, and this accounts for the low incidence I have observed of this infestation among Europeans in 'Iraq.

The expelled segments may be killed by burning, or by contact with such preparations as cresol, which is a part of the European's disposal of excreta in 'Iraq, but not, unfortunately, also that of the native population. With regard to symptomatic treatment, general



principles hold good and require no special consideration.

In hospital work in 'Iraq where one's ever-changing staff is in the main untrained, a routine treatment is advisable, and the following has proved the most successful in my hands.

A purge of castor oil is administered, and two days of semi-starvation follow, only milk or clear soup being allowed. A saline purge is given each morning, and, on the third morning, the following mixture is given, taken in two half doses at 8 A.M. and 9 A.M., respectively, followed by from half to one ounce of castor oil at 11 A.M.:

Ext. Filicis Liquidum	two drachms.
Mucilag. Tragacanth	two drachms.
Aq. Cinnamomi ad	two ounces.

The head should be searched for in the stools, and, in nearly every case, I have found it when this treatment has been carefully carried out. It facilitates the finding of the scolex if the motions following the vermifuge and purgative are passed into warm water, in a receptacle lined with black material such as crêpe, through which the fluid material may be strained away. The scolex is more readily seen against the dark background of the cloth than if no such provision is made. If the motions are passed into cold water, the segments are liable to contract, and be broken off, and the head may thus be left behind.

If the scolex does not come away, in 2 or 3 months mature segments again begin to appear, and the treatment in full must be repeated.

One must always be prepared for the presence of more than one <sup>variety of</sup> worm; this occurred in several of my cases, and will be considered under multiple infestations later.

With private patients, after similar preparation to that already described, I have found 15 minim capsules of liquid extract of male fern very satisfactory. Three doses, at 6, 6.30, and 7 A.M., on the third day, has been my practice, two capsules being given for each dose, followed, at 9 A.M., by an ounce of magnesium sulphate or castor oil. The main advantage of capsules is that they are tasteless, and extract of male fern has a very unpleasant taste. Theoretically, castor oil should not be given as a purgative following this anthelmintic, as filicic acid, the active principle of male fern, is poisonous, and, being soluble in oily substances, it may be absorbed, and produce toxic symptoms. In my experience there need be no apprehension on this account, and I have found castor oil most satisfactory in all classes of patients.

### 3. INFESTATION WITH TAENIA SOLIUM.

*Taenia solium* has a cosmopolitan distribution, corresponding in general to that of the domestic pig.

In spite of its universal distribution, there are certain countries in which the eating of pig is prohibited by the religion of the people. Mohammedans and Jews do not eat pork, so that in 'Iraq, where they represent 95% of the population, a low incidence is to be anticipated, and one's figures show that infestation among these two classes of the community in 'Iraq is

of the greatest rarity. The domestic pig does not exist in 'Iraq, but the wild boar is fairly common, and is a serious menace to sportsmen when shooting in thick undergrowth.

I have met with only 3 cases of this infestation in 'Iraq in 5 years; two of these were in male Armenians from the neighbourhood of Lake Van, and the other was a Mohammedan, a fellah from a village on the Euphrates.

In the case of the Armenians (Christians) a history of eating pig was obtained prior to them residing in 'Iraq. They were refugees, and had only recently arrived in Baghdad; both these cases came to my notice during the winter of 1922-1923, one in November, and the other in February.

The origin of the Mohammedan case, which I noted in March 1920, was most obscure. The man denied ever having eaten pig, and was even ready to swear to this at the Shrine of Abbas, in Kerbala - a fairly certain guarantee that he was speaking the truth, as the Shrine of Abbas is held in great awe by believers who anticipate certain death should they tell a lie at that place. I think that in this case infestation must have occurred from some other animal flesh, and, as rare cases have been recorded of the cysticercus of *Taenia solium* being found in mutton, I am inclined to believe that this man may have been true to his religion, and have become infested by means of mutton flesh.

The pathology and symptoms of this infestation are identical with those of *Taenia saginata*.

Beyond the passage of segments in the stools, none

of my three cases in 'Iraq presented symptoms.

Diagnosis is based upon finding segments of the parasite in the stools; it is not often that confirmation by the presence of ova in the motions is available.

The main points of difference between *T. solium* and *T. saginata* have already been mentioned, and, in view of the fact that an occasional case of *T. solium* infestation may occur among Jews or Mohammedans, one must guard against concluding that a tapeworm found in a patient of one of these classes must be *T. saginata* without careful examination of the segments passed. It is hardly possible to differentiate between the embryophores of *Taenia saginata* and *Taenia solium* on microscopical examination, but a simple method of distinguishing the two species is to place evacuated segments between two glass slides, and to press them slightly. The difference in shape of the uterus of the two species can then be readily appreciated.

#### PROGNOSIS.

This is, on the whole, good, but, owing to the fact that carriers of this parasite may infest themselves by uncleanness in defaecation, or by the act of vomiting, in which mature segments close to the stomach may be drawn into it, treatment is imperative, as soon as the diagnosis is made. Compared with *Taenia saginata*, this helminth must, therefore, be considered a more serious condition, and, in 'Iraq where cleanliness in defaecation is carelessly observed by almost the whole of the native population, it is



a kindly dispensation that facilities for infestation are almost non-existent.

#### TREATMENT

Treatment is identical with that of *Taenia saginata* already described. I treated my three cases with male fern with satisfactory results.

#### PROPHYLAXIS.

Prophylaxis against infestation with *Taenia solium* resembles that described against *Taenia saginata*, substituting pork and pig, respectively, for beef and ox.

There is, however, greater need for careful personal hygiene in this infestation, owing to man being more liable to act as an intermediate host. Contaminated water and uncooked vegetable foods, such as salads, must be guarded against, and cleanliness in defaecation, in order to prevent ~~auto~~-infestation in carriers, is a point requiring special consideration and instruction, and, I think, most satisfactorily to be carried out in schools.

#### 4. INFESTATION WITH *TAENIA ECHINOCOCCUS*.

Infestation with this parasite is cosmopolitan; in 'Iraq it is wide-spread, but uncommon in the towns-people, who do not usually keep dogs.

Every arab village or collection of tents abounds with dogs, large jackal-like animals which are excellent watch dogs, and are kept entirely for this purpose.

The manner in which the villager and tribesman lives with his dogs makes conditions for the spread of infestation very favourable, and the whole of 'Iraq, with the exception of the large towns, is apparently

uniformly infested though the incidence is not extremely high. Mohammedans regard dogs as unclean, and there is not the close association between man and dog as is seen in western countries, where dogs are kept as household pets.

There are two other important factors controlling the distribution of *Taenia echinococcus* infestation, namely, the frequent incidence of the parasite in dogs, and the presence of hydatids in cattle.

As the tribesmen eat relatively little meat there is not as much offal available for his dogs, and hence less risk of them becoming infested, or of infestation through them, reaching him. I feel that this is a most important factor, and, further, I have been assured by veterinary officers that the incidence of the disease among cattle in 'Iraq is a low one.

The following figures relating to admissions into the larger civil hospitals in 'Iraq are instructive. During 1921, out of 705 major operations (male) performed at the New General Hospital, Baghdad, 2 were for hydatid cysts of the liver.

During the same year at the Women and Children's Hospital, Baghdad, out of 1416 admissions, 8 cases of hydatid cysts occurred, and 2 cases proved fatal. Of these 8 cases, 7 had the liver affected, and 1 had a retro-peritoneal cyst.

In Mosul Civil Hospital, during the same year, of 692 major operations, and 2033 total admissions, 8 were for hydatids cysts of the liver.

In Basrah Civil Hospital, in 1921, out of 282

major operations (male), and 2105 total admissions (males) in all, 2 had Hydatid cysts of the liver. In the Women's Hospital, Basrah, during the same period, there were in all 622 patients admitted; two of these had hydatid cysts of the liver.

In Hillah, during 1919-1920, I met with 2 cases of hydatid cyst of the liver, and 1 case of multiple hydatid cysts of the peritoneal cavity in which enormous distension of the abdomen was present. One of the liver cases was a woman, the other two cases were adult males.

From these figures the occurrence of this infestation in both sexes in 'Iraq appears to be of about equal incidence, though I am surprised that the incidence in both is not much higher.

I have not observed the percentage incidence in native dogs, but I conclude that it is relatively a small one.

The localisation of the parasite in these 'Iraq cases shows a marked predominance for the liver, and this is in keeping with the statistics of other countries.

Compared with some other countries, the incidence in 'Iraq is extremely light. According to Finsen,<sup>1</sup> in every 43 persons in Iceland is infested, and from the figures for 'Iraq just noted, the proportion works out at only 1 in 524 persons.

Dogs become infested with the adult parasite by eating offal in which the hydatids occur. In 'Iraq man becomes infested, either by contaminated drinking

water, by too close association with dogs, by contaminated dishes, or by houseflies contaminating food.

#### SYMPTOMS.

##### (a) General.

In none of the cases coming under my observation in 'Iraq were constitutional symptoms marked. I have, however, noted pyrexia and a definite degree of anaemia and eosinophilia in some of my patients.

##### (b) Local.

Local signs and symptoms naturally vary considerably according to the site of the cyst.

When in the liver, the ribs may show an outward bulging, and the percussion note of the organ may show an extended dullness. Jaundice and ascites too may be present. If near the surface, on percussion, a curious "thrill" may be obtained, but my limited experience suggests that this "hydatid thrill" is not of nearly as much practical value as most text books would have one believe.

In one of my cases in which the peritoneum was affected, practically the whole of the abdominal cavity was involved. On palpation the abdomen suggested a huge multiple cyst the parts of which varied in size up to that of an orange. Operation in this case was not attempted beyond removing one of the cysts in order to confirm one's diagnosis. It is presumed that in this case the peritoneum may have become involved from a previous cyst of the liver which had burst, releasing daughter cysts which had in turn grown from the peritoneum.



In the lungs, hydatid cysts give rise to symptoms of compression, and, commonly, there is fluid in the pleural cavity of the affected lung.

In July 1923, Horresh, aet. 24, a Jewish clerk of Baghdad, consulted me, and complained of breathlessness and pain over the right lung behind. On examination there was dullness over two thirds of <sup>the</sup> lung, bulging of the ribs, and the liver was palpable.

On aspiration of the pleural cavity, clear fluid was found. No fever was present. Radiograms showed a large shadow in the right lung, in size and shape resembling an ostrich egg, and measuring 20 c.m. in the vertical, and 13 c.m. in the horizontal diameter. The shadow had no connection apparently with the liver; the liver was pressed distinctly downwards. Provisional diagnosis was a hydatid cyst, an enchondroma, or a malignant growth. The Wasserman reaction proved negative; no eosinophilia and no leucocytosis were found on blood examination. The Vineberg reaction for hydatids was strongly positive.

In April 1924 the cyst ruptured into a bronchus, and was coughed up; the patient was very seriously ill until a month later, when his convalescence commenced to be established.

In October 1924, the lung was found clear on both clinical and X-Ray examination, and there was no sign of enlargement of the liver.

In May 1925, there was an enlargement of the liver, and X-Ray examination then confirmed the presence of a large hydatid cyst of this organ.

I last saw the patient on November 26th 1925; the surgeons did not wish to operate at that time as the cyst lay deeply in the liver substance, and it was thought that it might be more readily reached later.

The patient was enjoying good health; he occasionally complained of a little fever, and of a feeling of fullness over the liver. The rate of growth was very slow, and, clinically, there was only very slight increase in the size of the liver since the preceding May.

The source of the infestation in this case is obscure. The patient had never in any way associated with a dog; contaminated drinking water, or salads, or other uncooked vegetables, probably supply the cause in this case.

As a rule, hydatid involvement only affects one organ, but re-infestation, or spontaneous rupture of an echinococcus, may result in multiple manifestations.

#### DIAGNOSIS.

Symptoms are commonly vague, and diagnosis may be a matter of great difficulty; there are, however, certain special aids which are very helpful in difficult cases, namely, the Vineberg reaction, the presence of eosinophilia, and X-Ray examination.

X-Ray examination is usually of great assistance, as hydatid cysts are capable of throwing a shadow, probably owing to the presence of a relatively large amount of calcium salts in their composition.

The common practice of an exploratory puncture with a needle is a very risky one, and should only be

used in exceptional cases. The cyst fluid is under great tension, and the puncture may cause it to burst, or, in any case, to leak and be most difficult to control.

#### TREATMENT.

The treatment of hydatid disease is surgical, and, where possible, the no-drain operation introduced by Bond and others, in preference to drainage procedures, should, in my experience, be adopted.

#### PROPHYLAXIS.

The most important factor in general prophylaxis is the prevention of dogs feeding on the raw offal of sheep and cattle. Personal prophylaxis requires that one's drinking water is free from contamination, or is filtered or boiled, that salads and uncooked vegetables are not eaten, and that close association with dogs is not practised.

#### INFESTATION WITH DIPYLIDIUM CANINUM.

This helminth is a common intestinal parasite of dogs, jackals, and cats, in 'Iraq. The larval stage of the parasite takes place in the dog-louse (*Trichodectes canis*), in the dog-flea (*Ctenocephalus canis*), or in the human flea (*Pulex irritans*).

Infestation in man is caused by swallowing an infested adult flea.

The infestation in 'Iraq is a rare one, and my cases, three in all, have occurred only in children; two cases I met with in Baghdad and one in Hillah. The two Baghdad cases were in infants under 2 years of age, the Hillah case in a child of 6 years; all three cases were males.

In none of the cases were symptoms attributable to the parasite discernible beyond the passage of segments of the cestode; it was on account of these cucumber-seed like bodies in the stools that medical advice was sought in each case.

In the two Baghdad cases, one Mohammedan and the other Christian, infestation presumably occurred from a cat, as each of the houses possessed cats as pets, and neither of them a dog. In the Hillah case, a Mohammedan, the child was sufficiently old to be able to run about, and as far as I could discover neither dog nor cat lived in the house. Presumably, in this case, the child was infested outside its own home.

#### TREATMENT.

I found the liquid extract of filix mas satisfactory in all three of my cases. In the case of the two infants I administered seven minims of the extract, and the dose was repeated after an hour, followed in two hours by an enema. In the case of the older child the dose given was fifteen minims, repeated, followed by three drachms of castor oil after two hours.

Although no specimens were brought to me in which I was able to find the heads of the worms, the passage of segments in each case ceased, and I was able to follow up each case for some few weeks, during which time no recurrence took place.

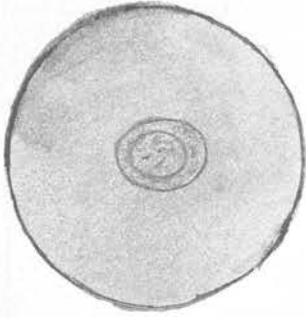
#### PROPHYLAXIS.

The ideal prophylaxis is, of course, to abolish household pets, and, where this is not possible, treatment of the pets is an alternative measure. Close

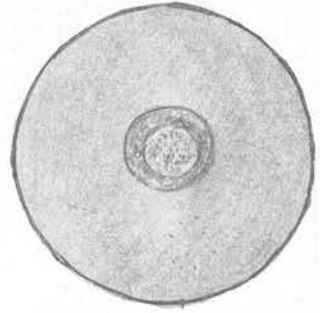


association with domestic pets is to be greatly deprecated.

CESTODE ONCHOSPHERES X 250

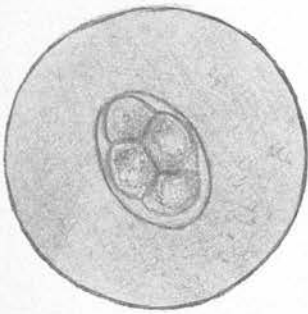


HYMENOLEPSIS NANA



DIPYLIDIUM CANINUM

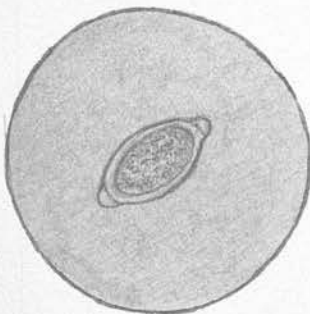
NEMATODE OVA X 250



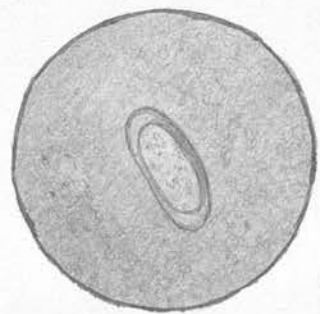
ANKYLOSTOMA DUODENALE



ASCARIS LUMBRICOIDES



TRICHURIS TRICHIURA



ENTEROBIUS VERMICULARIS

## SECTION X.

### THE NEMATHELMINTHIC DISEASES OF MAN IN 'IRAQ.

The Nemathelmia are bilaterally symmetrical, cylindrical, and unsegmented worms, and the phylum may be divided into 3 classes, namely :-

1. NEMATODA.
2. ACANTHOCEPHALA.
3. NEMATOMORPHA.

The Nematoda are cylindrical, non-segmented worms, usually filiform or fusiform in shape, and tapering at both ends; they are the only class of the phylum Nemathelmia represented in the helminthic fauna of 'Iraq.

### CLASSIFICATION OF NEMATODES PARASITIC IN MAN IN 'IRAQ.

These helminths are readily classified into 3 types, according to their form of oesophagus, thus:

OESOPHAGUS	}-	Simple Muscular Bulb	(Type "A")
	}-	Double Muscular Bulb	(Type "B")
	}-	Simple Cellular Tube	(Type "C")

The types are all represented in the helminthic fauna of 'Iraq, and may be grouped as follows as far as such representatives are concerned :



IRRIGATION IN 'IRAQ.

Chirds on the bank of the Euphrates near Hillah.



Type "A"

Oesophagus, a simple muscular bulb.	{	Mouth with 3 fleshy lips - Ascaridae.	{	Ankylos- tomidae.
		Mouth with cuticular		
		walled buccal capsule.		
		(Capsule bent dorsally.		
		Orifice guarded by cutting plates		

The family Ascaridae is represented by one parasitic helminth in 'Iraq, namely, *Ascaris lumbricoides*, and the family Ankylostomidae by two, namely, *Ankylostoma duodenale*, and *Necator americanus*.

Type "B"

Oesophagus, a double muscular bulb.	{	Skin striated.	{	Oxyuridae.
		Eggs bean shaped.		
		Single spicule in male.		
		Skin smooth.		
		Viviparous.		
		Two spicules & accessory pieces in male.		Angiostomidae.

The family Oxyuridae is represented in 'Iraq by *Enterobius vermicularis*, and the family Angiostomidae by *Strongyloides stercoralis*.

Type "C"

Oesophagus, a simple cellular tube.	{	Male has large	{	Trichosomidae.
		single spicule.		
		Female has		
		barrel-shaped eggs.		

The family Trichosomidae is represented in 'Iraq by *Trichuris trichiura*.

The Nematelminthic parasites of 'Iraq are therefore six in number, and their infestations will be considered briefly in turn.

# 1. INFESTATION WITH ASCARIS LUMBRICOIDES.

*Ascaris lumbricoides* is the largest round worm known to infest man, and it has a cosmopolitan distribution; in tropical and sub-tropical countries where the warmth of climate, and the insanitary conditions which prevail, favour spread of the parasite, it is, however, most prevalent. The parasite was known in ancient times and Plinius termed it *Taenia rotunda*.

Infestation with this parasite in 'Iraq is very common, both among town dwellers and the fellaheen, but more particularly among the latter.

During the year 1919-1920, in a series of 520 routine stool examinations which I conducted in Hillah, in patients both of Hillah town and district, 473 being adults, I obtained *Ascaris* ova in 88 cases, a percentage of 18.6; 47 of the examinations were of children, and 13 proved positive, a percentage of 27.6. 57 of the 520 patients were residents of Hillah town, and of these only 7 proved positive, a percentage of 12.2.

Of a series of 164 examinations I made of the stools of Baghdad residents during 1922-1923, 29 proved positive to this parasite, a percentage of 17.7; these gave the following results, classed according to their religions:

Adults	Religion	No. examined	No. positive	Percentage
1.	Mohammedans	27	4	14.8
2.	Jews.	64	9	14.0
3.	Christians	25	5	20.0
Total		116	18	15.5

Of the 48 children examined in Baghdad, 11 proved positive, a percentage of 22.9. The total being small, a division into the different religions may be of limited value, but, nevertheless, I append it, as, I think, it is of interest.

Children	Religion.	No. examined	No. positive	Percentage
1.	mohammedans	11	3	27
2.	Jews	23	5	21.7
3.	Christians	14	3	21.4
Total		48	11	22.9

During the year 1921, at the New General Hospital, Baghdad, of 156 stools examined for parasitic ova, 22 proved positive to *Ascaris lumbricoides*, a percentage of 14.1. These were exclusively adult patients, and all males.

My own figures, too, were mainly confined to males. Of my 116 adult Baghdad cases, 33 were females and gave a positive result in 6 cases, a percentage of 18. The figures are admittedly small, but suggest a higher incidence in females, a state of affairs which seems probable from the more frequent contact of the adult female population with uncooked food, and the greater risks involved by them in the preparation of food.

Among children, my figures suggest a fairly equal incidence in both sexes, though only 14 of 48 examinations were of females. Of these 14 girls, 3 proved positive, a percentage of 21.4, and of the 34 boys, I found ova on 8 occasions, a percentage of 23.5.

Infestations with *Ascaris lumbricoides* is the

commonest manifestation of helminthiasis seen among Europeans in 'Iraq, and I have had 6 such cases during the year (1925), 4 in females and 2 in males, all adults. One's figures suggest a percentage incidence at all ages, and in both sexes, among 'Iraqis, of slightly less than 20%.

*Ascaris lumbricoides* is also a very common parasite to find in multiple infestations in 'Iraq, but this will be discussed later in a special section dealing with the subject.

Where only male parasites exist, though this is uncommon, one naturally does not meet with ova in the faeces, and one must never overlook this possibility in cases suggesting *ascaris* infestation. I have known this to happen in not a few cases.

Where females only are present unfertilised ova alone are to be found, but, on finding fertilised eggs, one can be certain that both male and female parasites are present, and, until both sexes are expelled, treatment must be continued.

The adult normally inhabits the small intestine, but, not uncommonly, it is found in the stomach.

#### PATHOLOGY.

The pathology of ascariasis is mainly dependent on the abnormal wanderings of the worm. When in its normal habitat, in the small intestine, there may be no pathology, though, when many worms exist, volvulus or acute obstruction may occur.

In 1922, in the Women and Children's Hospital, Baghdad, Dr. Braham operated on a woman with acute



obstruction, and found a large mass of worms causing a blockage of the small intestine, and, in 1920, at the New General Hospital, Baghdad, Dr. Campbell Mackie had a case of Reichter's hernia, in the right femoral canal, which had become strangulated through the presence of a large round worm. The skin and underlying tissues had sloughed, and, on admission, there were two small sinuses on the surface of a hard reddened mass. A severe peritonitis developed and caused death in this case.

The existence of simple goitre, particularly in young adult women, is a notable clinical picture in 'Iraq.

The etiology of the goitre is still obscure, but I have been struck by the frequency with which this condition is associated with ascariasis, and I think it is worthy of careful consideration as a possible etiological factor in the causation of "endemic goitre", in 'Iraq at least.

An ascaris may wander into the pharynx, nose, or nasal pharynx, being probably expelled to such sites by the act of vomiting. I myself have met with two cases in 'Iraq in which parasites have escaped through the nose.

The presence of ascaridae in the stomach is fairly common in the country as evidenced by the frequency with which they are vomited.

In August 1924, I performed a post-mortem examination on an adult arab drowned in the river Diala; the post-mortem examination was performed within a few

hours of death. The findings were consistent with death from drowning, but, in the stomach, I found 5 large ascaridae, 3 female, and 2 male, the heads and half the body of one male and one female occupying the cardiac orifice. These might conceivably have migrated to the stomach after death, though, as I found no other worms in the small intestine, I am inclined to believe that the stomach had been the chosen habitat for some time. I found a small hydatid cyst of the liver, and schistosome invasion of the bladder, but no other pathological lesions of any importance. The man was a strong swimmer, he had been seen entering the river, and he was seen swimming shortly before he was missed; there was nothing to point to suicide, which is a rarity among arabs. There was no water in the stomach, but the organ contained a portion of a large meal; part of this meal was also found in the oesophagus, pharynx, nasopharynx, and mouth.

There is, I think, in this case the interesting possibility that the presence of the worms about the cardiac orifice induced vomiting, and that reflex faintness then occurred, and that the unfortunate arab was drowned as a result.

#### SYMPTOMATOLOGY.

One's experience is that in the most majority of cases the presence of *Ascaris lumbricoides* causes no signs or symptoms whatever, and that, in any case they are usually most indefinite, and very mild.

Excessive appetite may be noted, but I have noted loss of appetite just as often. Foetid breath,

abdominal tenderness, attacks of intestinal colic, together with dyspepsia of an atonic variety, and irregularity of the bowels, have been the commonest features of my cases, but the clinical picture tends to be most indefinite.

In children, anaemia is common, and, in a few cases, I have noted loss of weight to such a degree that, together with intestinal symptoms such as diarrhoea and meteorism, the clinical phenomena have been strongly suggestive of a tuberculous enteritis. This enteritis verminosa, if not too advanced, fortunately responds readily to treatment, the essential point of which is expulsion of the parasites.

On three occasions I have been called in consultation on children of about 10 years of age, in which the diagnosis of typhoid fever had been made by the local doctor, and the continuous fever, abdominal tenderness, furred tongue, and diarrhoea, which were present in each case, certainly gave them a good deal of clinical support.

In all these cases, however, splenic enlargement was missing, the degree of fever lower than one would expect in the second week of typhoid fever, and mental irritability and restlessness was very pronounced. Bearing in mind the possibility of a typholumbricosis, I had the stools examined, and found numerous ascaris ova present in each case, and, by the expulsion of the parasites with immediate cessation of symptoms, one's diagnosis of ascariasis was confirmed.

Reflex nervous symptoms alone have been noted in a number of my cases, usually, however, associated with a low degree of fever.

One of these cases was of peculiar interest, being the cause of much domestic distress. I was consulted by a local Christian in the autumn of 1923, who told me that he was newly married, and that he was afraid his wife was becoming insane.

She was disinterested in her home, very emotional, and irritable, had excessive sexual desire, and marked mental depression.

On examination, I found the wife to be free from any organic disease, but she had slight fever, and was very despondent. I managed, however, to elicit the history of the passage of a round worm a few days previously, and numerous ova were found in her stools. I administered santomin in 5 grain doses on three successive nights, followed on the first and last morning by an ounce of castor oil, and I was rewarded by the expulsion of 14 adult worms, by immediate cessation of her symptoms, and the restoration of domestic peace.

The more one practices in an eastern country, the more impressed is one that the possibility of ascariasis should never be lost sight of in vague cases pointing to gastric or nervous disease.

In July 1924, I was called in consultation by a Baghdad doctor to a case of persistent vomiting in a Jew aged 35 years, who complained in addition of a week's continuous fever. He was a resident of



Mendali, but had come to the house of relatives in Baghdad for treatment.

On examination, I found a well-built and well-nourished man with a temperature of  $101^{\circ}$  F, and a pulse rate of 84; a relatively slow pulse rate is in my experience usual in ascariasis.

He complained that he could keep no food in his stomach for more than a few minutes, and he further complained of much pain in the epigastrium. There was a very slight degree of jaundice, and distinct tenderness on palpation over the upper part of the epigastrium; definite rigidity of the abdominal wall was present in the same area.

The vomit contained no mucus, so that the diagnosis of acute gastritis made by the local doctor seemed hardly probable. There was a history of blood and mucus in the stools 12 months previously, and with the possibility of an amoebic abscess of the liver being present I had a stool examined. The stool showed numerous *Ascaris* ova together with a few ova of both *Ankylostoma duodenale* and *Trichuris trichiura*. Santonin was administered, and one male worm expelled, but, as the ova were fertilised, one felt certain that a female worm was also present; a second dose of this anthelmintic produced a large female specimen whereupon the fever speedily ceased, and all symptoms cleared up within 5 days.

In very young children I have observed convulsions caused as a result of *Ascaris* infestation, and, in a few adult cases, urticaria has been a pronounced

feature of the infestation.

In my experience, no reliance can be placed on the absence of eosinophilia, though its presence is naturally in favour of helminthic infestation; in most of my cases no eosinophilia existed.

#### DIAGNOSIS.

Direct diagnosis usually rests on the finding of the characteristically shaped ova in the faeces, which must be fresh; mis-identification of an adult worm, should one have been passed, is hardly possible.

Stool examination for helminthic ova in any case of doubtful diagnosis in the tropics or sub-tropics is, in my opinion, a most important clinical measure.

Examination for helminthic ova is easy and quickly performed, and only too often one has been saved from a diagnostic error by this simple procedure.

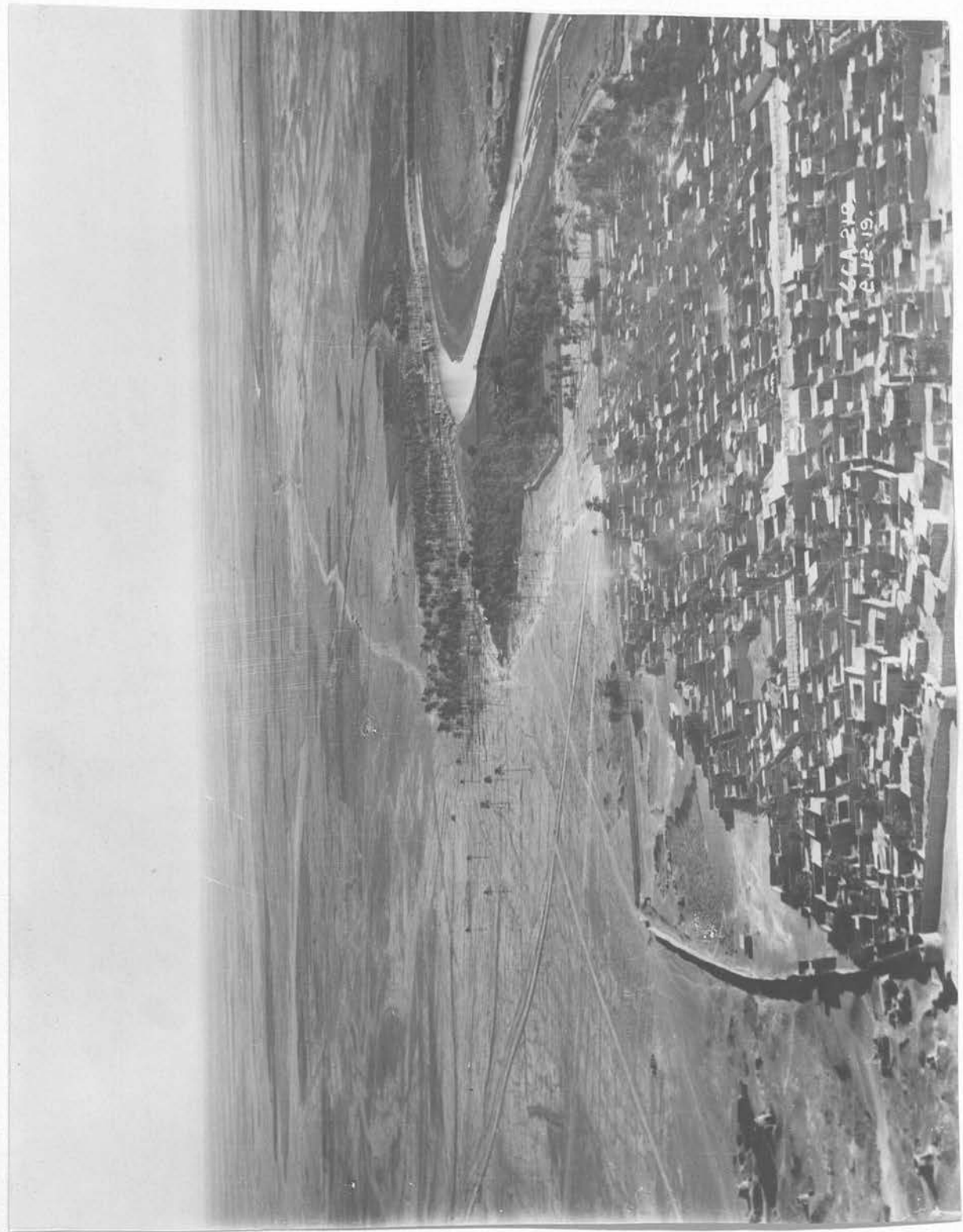
#### PROGNOSIS.

When the parasites are in their normal habitat, the prognosis is good as the worms are readily expelled; when, however, the parasites wander, the prognosis is obviously more serious in proportion to the site of wandering.

#### TREATMENT.

My own procedure, both for Europeans and 'Iraqis, is to give santonin on three successive nights, and on the first and last morning to give a dose of castor oil. This method I have found very successful, and the fact that one has often had worms expelled after the third dose proves that three doses are not excessive. In no case were any alarming symptoms presented by this

SHATT - AL - HILLAH.  
(Hillah branch of Euphrates).



Showing a portion of Hillah town on the left bank  
of the river.

treatment.

The anthelmintic should, when possible, be preceded by fluid diet for two days, only milk and broth being given; this preparation I have found to be very advisable for the successful expulsion of parasites.

For a child of 1 to 2 years, I give 1 grain of santonin, and increase the dose in proportion to the age, reaching a maximum of 5 grains for an adult. With adults, I usually prescribe the drug in capsules, with children in powder form.

In a number of instances in children, I have combined the santonin in a powder with calomel and compound powder of scammony, but I have not found this method to possess any advantage over the one just outlined.

Occasionally giddiness and colour disturbances of vision are complained of, but, in my experience, they are very temporary and of little importance.

I have never noted either convulsions or collapse with the doses of santonin just described.

Oil of chenopodium is undoubtedly very efficient, but being more toxic, and disagreeable to the patient it is not, I think, as suitable for general use.

Ankylostomiasis and ascariasis commonly co-exist in 'Iraq, and while treating the former with oil of chenopodium, the expulsion of ascaridae at the same time as the ankylostome has been most striking.

#### PROPHYLAXIS.

The proper disposal of faeces regulates this subject. In the town houses of 'Iraq cess-pit latrines



are universally employed, and, when filled, their contents are carried outside the town by donkeys to special dumping grounds. Being greatly prized as a plant fertiliser, this faecal material is much employed for vegetable and salad crops; the agriculturalist carries it away to his gardens from these dumping grounds.

In the cess pit latrines ova of *Ascaris lumbricoides* can survive for 4 or 5 months.

A number of latrines, say one half, are emptied only once annually, but a large number require to be emptied every few months, and, in this way, live ova are readily distributed in the sludge to the soil and crops of the neighbourhood. Once soil is contaminated, it may remain so for years so resistant are the ova to climatic changes.

In the village faeces are usually passed either on the roof of the dwelling, in a neighbouring garden, or on the river bank, and this contamination of soil and water is a big factor in spread in 'Iraq.

Eggs may be blown about by the wind, so that faeces passed on the ground are a further possible cause of spread in this way.

Flies too may swallow ova, and, by their faeces, infest human food.

In countries where pigs are kept, their faeces also require proper disposal, but this does not apply to 'Iraq, where only a few wild pig exist.

All these factors, however, revolve round the proper disposal of faeces, and, in 'Iraq, the problem

is one of increasing urgency.

Controlled water sewage system for the towns, and public latrines for the villages, are the most important prophylactic measures against ascariasis in 'Iraq. Uncooked vegetables should not, of course, be eaten; as early as 1901 Metschnikoff emphasised this point. One has only to watch lettuces being washed at any and every flowing canal or stream, prior to being sent to the bazaars for sale, to appreciate how readily infestation may be spread by salads.

## 2. INFESTATION WITH ENTEROBIUS VERMICULARIS.

### DISTRIBUTION.

The distribution of this parasite is world-wide. 'Iraq is a heavily infested country, and undoubtedly much more so than routine stool examinations would tend to show.

In my experience, it is uncommon to find ova of *Enterobius* in the faeces. From my figures, I estimate that less than one infested case in every six is likely to show ova on routine microscopic examination, and the reason for this is supplied by consideration of the life history of the parasite. When the ova are ripe the female worm lays very few of them in the intestines, but crawls out of the anus, and deposits her eggs about the buttocks of her host.

My Hillah figures, during 1919-1920, gave 25 positive findings in 520 stool examinations, a percentage of 4.8, and my Baghdad figures, during 1922-1923, gave 5 positive results in 164 routine examinations, a percentage of 3.04. In these figures the percentage in

children was slightly higher than in adults, my Baghdad figures, for example, being as follows :-

		<u>No. positive</u>	<u>Percentage.</u>
Adults	116	3	2.6
Children	<u>48</u>	<u>2</u>	<u>4.03</u>
	164	5	3.04

In view of the smallness in number of the positive findings, I have not considered separation of them into the different religions.

There is a further interesting point in these figures, and that is that the country dweller appears more liable to infestation with this parasite than does the town dweller.

Of the 520 Hillah examinations, 463 were fellaheen, and 24 of the 25 positive results were obtained in these, a percentage of 5.1, whereas, in the 57 residents of Hillah town, I only obtained positive findings in one solitary case, a percentage of 1.7. The greater incidence among the rural population appears to be due to the close co-habitation, cruder sanitation and hygiene, which exists among the fellaheen.

#### PATHOLOGY.

In cases in which the pathology is marked, the rectum is usually congested, and covered with blood-stained mucus.

The entry of parasites into the appendix may precipitate an attack of appendicitis, and, in some countries, the relatively high incidence of appendicitis is thought to be due to the presence of these parasites. This can hardly be true of 'Iraq, however, as the incidence of appendicitis is very low, as the following

figures indicate.

During the year 1921, at the New General Hospital, Baghdad, of 705 major operations performed (all males), only 7 were for appendicitis.

During the same year, at the Women and Children's hospital, Baghdad, of 521 major operations performed only 4 were for appendicitis.

At the Civil Hospital, Mosul, during the same year, of 641 major operations (male and female), only 1 was for appendicitis.

During the year 1921, at the Basrah Civil Hospital, 282 major operations (male and female) were performed, and only 2 of these were cases of appendicitis.

Thus of 2149 major operations, in all, performed on 'Iraqis, only 14 were of appendicectomy, a percentage of only .65. This figure is far below that of home hospitals.

#### SYMPTOMATOLOGY.

In cases in which infestation is slight, the patient has usually been symptomless, but, in moderate and severe infestations, both local and general symptoms have usually been noted.

The local symptoms have consisted mainly of irritation about the anus, particularly at night time. An eczematous condition of the perineum has commonly resulted from the scratching induced, and I have noted fissures and fistulae about the anus in a number of my cases.

Tenesmus with the passage of much mucus is a common manifestation of this infestation in 'Iraq, and many of



my cases had been previously labelled dysentery by their local doctor, and it was only on the failure of emetine hydrochloride injections (bacillary dysentery is rare in 'Iraq) to check the condition, that my advice had been sought.

I have seen prolapsus ani, due to the proctitis and straining caused by the presence of *Enterobius vermicularis*, in a number of cases in children, but only once in an adult 'Iraqi.

The irritative phenomena being most marked at night time, interference with sleep is common, and, in its train, nervous irritability is a common feature of the disease; in old standing cases I have known neurasthenia result. The Jewish community in 'Iraq seems especially prone to nervous phenomena when infested with *Enterobius vermicularis*.

I have noted a suggestively high incidence of haemorrhoids in my adult cases of this infestation; I think probably as a result of the proctitis present extending to the veins.

The general health is liable to suffer from the chronic intestinal catarrh, and also from the loss of sleep so commonly resulting, but, in this respect, the villager seems more resistant than the town dweller.

In the case of boys, masturbation was a common feature in my cases; in all probability due to sympathetic nervous excitation from the rectum.

In 3 of my adult male cases, there was present dermatitis of the scrotum associated with marked irritation, together with <sup>an</sup> eczematous condition about

the perineum and anus; in two cases the dermatitis extended down both thighs and resembled an intertrigo. Majochi has given to this condition the name of *Oxyuriasis cutanea*.

Anaemia has not been a noticeable feature of my cases.

#### DIAGNOSIS.

Diagnosis is not, as a rule, very difficult, as the irritative symptoms about the anus are strongly suggestive, and the presence of small white worms has usually been noted by the patient in his faeces.

As I have already emphasised, stool examinations give but a fractional idea of the true number of positive cases, and one's diagnosis, too, is usually dependent on finding the parasites in the faeces.

I have met with a considerable number of cases of chronic resisters to treatment in 'Iraq, in whom nothing has seemed able to remove the parasites, and the infestation has persisted indefinitely.

#### TREATMENT.

This requires consideration under two heads, namely, general, and local.

General treatment aims at preventing re-infestation by the fingers, and drawers for night wear are very useful in this respect. Infested persons should sleep alone, and take great care to scrub their hands and nails after defaecation.

I have purposely used the expression "general treatment aims at", as education in 'Iraq is not sufficiently advanced for general observance of such

measures.

With regard to drug treatment, it is only among better class, or in hospital patients, that treatment by enemata is practicable in 'Iraq. The fellah will not attend daily for this treatment, and I have found that the safest and most satisfactory remedy with them, allowing them to take the drugs away, and use them at home, is santonin given on three successive nights, in the same way as described previously for the treatment of ascariasis, together with the application of unguentum hydrargyri. For an adult I supply one ounce of the ointment, and each patient is instructed that this supply is sufficient for one week, and that it is to be smeared about the anus and perineum at bedtime. A valuable adjunct to this treatment, and one which I always advocate, is to apply the ointment also beneath the finger nails.

If necessary, I repeat the administration of santonin after an interval of 10 days.

With children, I am in the habit of diluting the mercury ointment with vaseline, as I find continuous application of the undiluted ointment with them may cause irritation. I prefer unguentum hydrargyri to the milder mercurial ointments.

#### PROPHYLAXIS.

Polluted water, raw vegetables, and salads are the usual primary source of infestation, and need to be guarded against.

Once *Enterobius vermicularis* is established, the prevention of re-infestation becomes of special importance.

### 3. INFESTATION WITH ANKYLOSTOMA DUODENALE.

Infestation with *Ankylostoma duodenale*, or ankylostomiasis, ranks only second in importance to schistosomiasis among the helminthic diseases of 'Iraq, both medically and economically.

In 'Iraq, the disease is mainly confined to the fellaheen whose daily work exposes them to contact with water or damp soil, in which larvae of *Ankylostoma duodenale* exist.

The worms live in the jejunum, and, less commonly, in the duodenum; they are, however, occasionally to be found in the stomach. They attach themselves to the mucous membrane by means of their buccal capsules.

#### DISTRIBUTION.

The parasite is to be found in almost all tropical and sub-tropical countries, and, in 'Iraq, infestation with this parasite is wide-spread.

The distribution in 'Iraq closely resembles that of schistosomiasis, dependent on the similarity of the life histories of the two parasites.

Like schistosimiasis, ankylostomiasis is not common in the larger towns, and is essentially a disease of the fellaheen. I have, however, had cases undoubtedly infested in large towns such as Baghdad and Hillah. I had 5 cases in the autumn of 1922 among residents of Baghdad, all coolies employed at a brick-field at Bab-al-Wastani, on the north-east outskirts of the city. Their infestations were definitely traceable to their place of labour. Defaecation among the labourers at this brick-field was performed in



the pits from which the earth was removed for brick-making, and infestation followed the handling of damp earth, and the process of barefooted puddling which constituted the constant occupation of the coolies.

The fellah lives on the verge of starvation; his diet is almost meat free, and it contains far too little fat; a diet mainly consisting of bread, rice, dates, vegetables, and milk, does not afford much resistance to the ravages of *Ankylostoma duodenale*.

Town dwellers show a much lower incidence of infestation than the fellaheen owing to their non-agricultural pursuits, and, too, because they have adopted foot-wear, while the fellaheen remain barefooted.

During 1921, of 365 stool examinations of all kinds performed at the New General Hospital, Baghdad, 35 were positive to *Ankylostoma duodenale*. In 1922, I read a paper on the subject of "Ankylostomiasis in 'Iraq" before the Baghdad Medical Society, and, included in the members present, were a number of ex-Turkish officials who had been working in 'Iraq prior to the late war. The presence of this disease in the country was a surprise to most of those present. One has not had either sufficient time or opportunity to date to investigate the incidence of this disease with the thoroughness one would wish, but my figures at least indicate that the disease is both wide-spread, and of a high incidence throughout 'Iraq.

In 1919-1920 in Hillah, in 520 routine stool examinations, ova of this parasite were found in 78,

a percentage of 15. 463 of the patients were from outside the town, and yielded 73 of the positive findings, a percentage of 15.7, and, in the remaining 57, residents of Hillah 5 proved positive, a percentage of 8.7.

Sedimentation methods were not used in these examinations, so that the numbers may be accepted as being well below the incidence. The above figures show clearly the strikingly higher incidence among the rural population as compared with the town dwellers.

During 1922-1923, of 164 stool examinations performed on residents of Baghdad, I only obtained positive results in 5 cases, all brickfield coolies as already noted; this series gives a percentage of only 3, and again demonstrates the low incidence among town dwellers.

During 1922, in my wards at the New General Hospital, Baghdad, 7.5%, of a series of 400 of my patients (males), were found to be suffering from ankylostomiasis; these included both town dwellers and fellaheen.

As with schistosomiasis, north of Baghdad ankylostomiasis is not very prevalent; it reaches its maximum intensity on the Euphrates, about Diwaniyah and Dagharah.

Of the 30 cases included in the series of 400 patients just mentioned, the following localities were represented as follows:-

<u>First Zone.</u>	<u>No. of cases of Ankylostomiasis.</u>
Kirkuk ..	<u>1</u>
Total of First Zone.	<u>1</u>

## Percentage of Cases in 1st. Zone 3.3%

Second Zone.                      No. of cases of Ankylostomiasis.(a) Tigris.

(a) Turmia	..	3
(b) Gorma	..	1
(c) Sumaichah	..	1

(b) Euphrates.                      ..                      0

(c) Diala.

Mendali	..	1
Abu Jisra	..	1
Baqubah	..	2
Deltawah	..	1
Total of Second Zone	..	<u>10</u>

Percentage of total cases in 2nd Zone 33.3%

Third Zone.(a) Tigris.

Khadhimain	..	1
Baghdad	..	5
Karradah	..	1
Baghailah	..	1
Kut	..	1

(b) Euphrates.

Yoosifiyah	..	2
Hillah	..	1
Hindiya	..	1
Najaf	..	1
Abu Sukhair	..	1
Diwanayah	..	1
Dagharah	..	3
Total of Third Zone	..	<u>19</u>

Percentage of total cases in 3rd Zone 63.3%

These figures are low, and so possibly have a margin of error in their relative percentage, but, at least, I think they emphasise that the greatest incidence is in the third zone, and, furthermore, that the Euphrates community shows the greatest incidence. The third zone Tigris figures are buoyed up by a series of 5 cases already mentioned, and so give an exaggerated

figure for this area.

The fact of the presence of ankylostomiasis in 'Iraq not being known to many local doctors, presents the interesting question of the possibility of this helminthic infestation having being imported by our Indian or Egyptian military personnel during the late war.

Certain it is that many millions of ova of this parasite must have been voided in the country by our native troops, but it is impossible for me to believe that ankylostomiasis did not exist before the British Occupation of 'Iraq.

In 'Iraq, as in other countries, age and sex are only factors in spread in so far as they expose to infestation, and they are dependent on occupation.

The work of the agricultural labourer renders him most exposed to possible infestation by contaminated earth and water, and it is mainly in this class of the community that ankylostomiasis is prevalent, and, furthermore, between ages in which such work is most commonly engaged, namely, between the years of 10 and 35.

Personal hygiene is an important factor in infestation; to the mouth the larvae may be carried by soiled and unwashed hands, and contaminated dishes, and it is just among the uneducated fellaheen most exposed to infestation that personal hygiene is almost totally wanting. Character of food plays an important part in the etiology as it is mainly among poorly fed inhabitants that ankylostomiasis is rife.





DIALA RIVER, near BAQUBAH.  
A tributary of the Tigris.

The river bank is covered with human faecal accumulations and forms an ideal site for the spread of ankylostomiasis.

Among my other duties in 1920-1921, I had charge of a large dispensary in Baghdad, and at that time I issued a report containing the following paragraph, which, though it referred mainly to the poor of Baghdad, is, nevertheless, even truer of the poor fellaheen.

"The community as a whole maintains a dull dietary in which carbohydrates figure most prominently, followed at a distance by proteids, and greatly after by fats".

Such a dietary does not tend to increase the resistance of an exposed person against infestation, and not only that, but the very nature of the food tends to gastric and intestinal catarrh by the large quantity of carbohydrate, mainly bread and rice, which the fellah has to consume in order to obtain sufficient nourishment for his economy.

Thus the fellah is a ready prey to this disease, and, in 'Iraq, the almost universal prevalence of pyrrhoea alveolaris, in my opinion mainly due to doughy portions of arab bread (khubz) sticking round the teeth and there decomposing, cannot but further lower resistance to infestation. Disposal of faeces, and control of water supply, are further important factors in the spread of ankylostomiasis in 'Iraq.

It is, I think, of interest to note that all my cases but one have been Mohammedans; I have record of only one Jew suffering from ankylostomiasis in this country, a man, aged 35, engaged in fruit growing at Mendali, a case of multiple infestation with *Ascaris lumbricoides*, *Ankylostome duodenale*, and *Trichuris trichiura*.

## PATHOLOGY.

Anaemia is a constant feature of ankylostomiasis in 'Iraq.

I have been fortunate in attending a number of post-mortem examinations associated with this condition, and the pathological findings have in all cases been fairly identical.

Before mentioning the usual lesions found in post-mortem, there is one condition which I would mention as being frequently associated with ankylostomiasis in 'Iraq. I speak of atrophic cirrhosis of the liver. The prevalence of this condition in 'Iraq is very striking, and its distribution appears to be co-incident with that of ankylostomiasis.

In almost all my cases alcohol could be definitely excluded as a factor, so that the appellation "alcoholic cirrhosis" as applied to this condition cannot stand in so far as it concerns 'Iraq. 3% of the admissions into my wards of the New General Hospital during 1922-1923 were advanced cases of atrophic hepatic cirrhosis, and in one third of these ankylostome ova were definitely demonstrated in the stools, either alone or as a mixed infestation with *Ascaris lumbricoides* and *Trichuris trichiura*.

Dr. Mills kindly sectioned portions of liver and spleen from three of my fatal cases of atrophic hepatic cirrhosis. In each case similar findings were noted. The following typical report relates to Hussain ibn Hussain.

"The liver shows marked chronic inflammatory



Case of ankylostomiasis associated with atrophic cirrhosis of liver.



change in the form of a well marked peri-portal cirrhosis." "The groups of liver cells enclosed by the fibrous bands are large in area and fairly regular in form." "The larger bile ducts show marked concentric lamination of fibrous tissue although the lumen does not appear to have been constricted to any extent."

"There is also marked proliferation of the bile ducts extending throughout the fibroid areas". "There is marked venous stasis in the portal vein radicles." "The parenchymatous cells exhibit cloudy swelling and fatty infiltration, although the majority of nuclei stain fairly well."

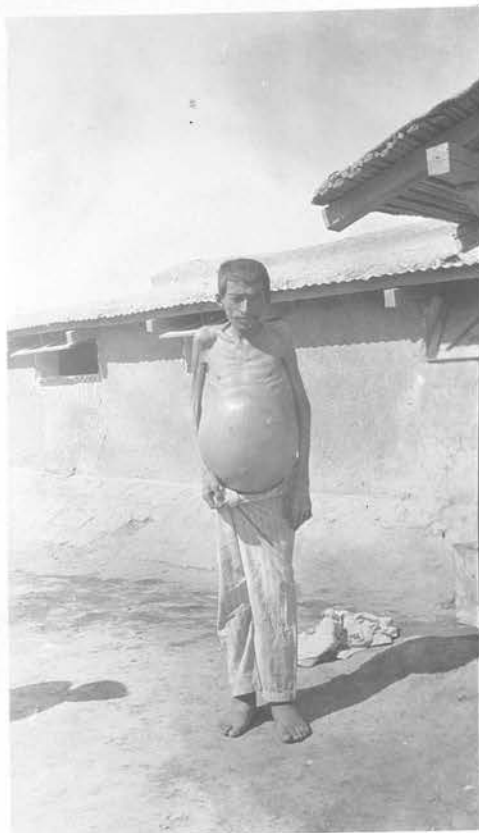
"The spleen shows a generalised increase in fibrous tissue, and multiplication of the fibroblasts with general degeneration of the malphigian collections of cells".

"There is a marked venous congestion and dilatation of all blood channels."

"All the cellular nuclei are staining badly which one may take as indicative of a very low state of functional activity, the result probably of combined toxic action and pressure atrophy."

Further investigation on this subject is needed, but it is my belief that intestinal helminthic infestations, and more particularly ankylostomiasis, have a very real etiological significance in this condition in 'Iraq.

Post-mortem examination of fatal cases of ankylostomiasis usually present a dilated, and less



ANKYLOSTOMIASIS.

Epigastric scarring by burning is to be noted.  
Atrophic cirrhosis of liver also present.

commonly, a hypertrophied heart. Clear serum, non-inflammatory in nature, is usually present in the abdominal cavity, and less frequently in the pleurae.

In cases in which an atrophic liver was not found, this organ usually displayed a fatty degeneration. The kidneys were usually pale and slightly enlarged, and the stomach inflamed and dilated. Parasites were usually found in the jejunum, both free and attached to the mucous membrane. In my cases the spleen was almost invariably enlarged, pale and soft, but a previous malarial infection was probably responsible for some of the enlargement in many cases.

The lungs were usually congested, and in many instances gave evidence of an active super-added tuberculous infection.

In cases unassociated with hepatic cirrhosis, emaciation was not marked, but there was a pallor of the muscles and of most mucous surfaces.

#### SYMPTOMATOLOGY.

The severity of this infestation varies with the resistance of the individual, the number of worms present, and the co-existence of other diseases.

The resistance of the individual is mainly a question of nutrition, and, as already noted, the poor fellaheen are in the main badly nourished in 'Iraq; in a number of cases there seems to be a special idiosyncrasy to the presence of ankylostomes, probably an idiosyncrasy to a toxin produced by them.

In 'Iraq, I think this factor is of more importance

from the point of view of symptomatology than the number of parasites present.

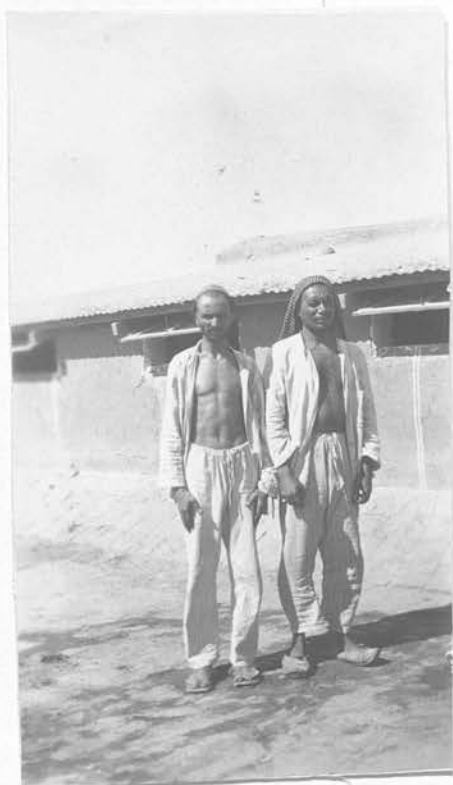
The distribution of ankylostomiasis and schistosomiasis in 'Iraq being so similar, it is not surprising to find the two diseases co-existing in the same individual, and, though there are unquestionably greater facilities for infestation in these parts than elsewhere, there is presented the interesting possibility that the presence of ankylostomiasis may predispose to schistosomiasis, and vice versa, and one's observation certainly point to a greater liability to infestation with ankylostoma duodenale in persons suffering from schistosomiasis, the lowered vitality caused by the latter disease being presumably the main factor involved.

The manifestations of ankylostomiasis in 'Iraq readily fall into three main types, namely, cryptic, moderate, and severe.

The cryptic cases commonly present no symptoms, but, being "carriers", they are important factors in the spread of the disease, and, particularly, as a large proportion of ankylostomiasis cases are of this nature.

In other light cases there may be a slight debility, pain, and tenderness, in the epigastrium, heartburn and flatulence; palpitation and a quickened pulse rate, too, are common. Examination of the blood may show eosinophilia. Vague nervous symptoms are not infrequent in these cases, of which mental depression and forgetfulness are commonest in my experience.





ANKYLOSTOMIASIS.

Two mild cases.

Even in the mildest cases, it is often possible to elicit a history of dermatitis of the legs and feet; this skin lesion precedes any other manifestations of ankylostomiasis by from two to four or more months, and commences a few hours after exposure to infestation.

Moderate cases show a mild degree of anemia, and digestive upset. Tenderness in the epigastrium is usually a cause of complaint, and an acid dyspepsia usually co-exists. On being asked where his trouble is, the most invariable reply of the fellah is "fwoidi", or "fwoidi har", meaning "the pit of my stomach", "the pit of my stomach is hot", respectively. In an endemic area such a reply at once arouses one's suspicion, and, in ~~some~~ cases, other than the most recent, scarring of the epigastrium is usually to be found.

Scarring or branding, a heroic effort at relief from the epigastric distress, is performed by the village "hakeem", or "medicine man", in one of three ways.

A linear scar signifies the use of a heated metal bar, while circular scars are of two varieties, the commoner being obtained by the application of a piece of cloth wrapped round a stick, dipped into spirit, lighted, and applied, the other by a red hot piece of metal piping.

The photograph on the following page shows typical examples of scarring in ankylostomiasis cases. Occasionally, instead of burning, a seton is employed; a piece of thick string is used, but this means of counter irritation has not nearly such a vogue as the



ANKYLOSTOMIASIS.

Two cases showing typical epigastric burn scars.

other.

The stools in moderate cases usually contain much undigested food; the bowels are irregular, periods of diarrhoea and constipation commonly alternating.

Palpitation and dyspnoea are constant features in these cases, and a quick ~~and~~ pulse, cardiac hypertrophy, dilatation, systolic murmurs, and vertigo, may be associated.

The mental condition of the patient is usually one of definite lethargy and depression, and visual disorders are common. Neuritic pains are complained of, and the knee jerks commonly show diminution.

The general nutrition does not as a rule show much change, but there is pallor and puffiness of the face, and a generalised muscular flabbiness.

The blood picture is fairly characteristic. The colour index is low. In my series of cases the haemoglobin averaged a little over 45 percent, and the red blood corpuscles numbered slightly under 4,000,000 per cmm. The degree of eosinophilia averaged just under 11 per cent.

Severe cases are usually the result of frequent re-infestation, and so are only met with in the heavily infested districts.

Moderate and severe cases of ankylostomiasis start a vicious circle in so much as the disease incapacitates the fellah from his work, and so incapacitated, his already frugal dietary cannot be digested, and through lack of sufficient nourishment, the disease manifestations become aggravated.





Four cases of ankylostomiasis.  
Two of the cases show ascites associated with atrophic  
cirrhosis of liver.

in severe cases, the symptoms are similar to those described for moderate cases, but they are more intense. Abdominal distension in such cases is common in 'Iraq, and is often associated with dilatation of the stomach. The presence of blood, and, more rarely, mucus, I have noted in the stools of a few cases. Oedema of the feet and ankles, and a generalised anasarca, may supervene, and the muscular weakness become so pronounced that the patient is totally incapacitated.

The blood picture in these cases usually alters; eosinophilia is not so marked, and may be totally absent, and the colour index may rise above 1, and the picture in every way resemble pernicious anaemia.

It is difficult to obtain a satisfactory drop of blood for a film in such cases, as the blood flows over the surface of the part pricked, and does not stand out as a drop; in addition it does not spread over a slide as well as does normal blood. The coagulation time shows distinct increase.

Fatal cases of ankylostomiasis are by no means rare in 'Iraq, and sparsity of population is probably the main factor in preventing the death rate from this disease from reaching a much higher level.

The heart in severe cases is weak and irregular, and there is usually pronounced throbbing to be seen in the epigastric region, a throbbing of which the patient is usually distressingly aware. With the palpitation there is marked dyspnoea, and haemic murmurs, usually systolic in time, are to be heard in

all auscultatory areas. Dilatation of the heart is common in such cases.

The general appearance of these severe cases is very similar to "the large white man" described by the late Professor Wyllie, and strongly suggest a nephritic condition. There is a curious dead-white tint of the conjunctivae in ankylostomiasis which I consider of distinct value in diagnosis.

In my severe cases pains in the joints have always been elicited.

The nervous system is seriously affected in marked cases. Mental fatigue is often extreme, and headache and depression have occurred in almost all my severe cases.

In children ankylostomiasis is a not infrequent cause of stunted growth, and it is often associated with a very protruberant abdomen.

#### DIAGNOSIS.

In districts in which ankylostomiasis is prevalent, the existence of anaemia, particularly if associated with eosinophilia, is sufficient to suggest microscopical examination of the faeces, and, if ova are present, there is usually little difficulty in recognising them owing to their characteristic appearance.

Sometimes in late stages of the infestation symptoms persist although no parasites are present, and no ova are demonstrable in the faeces, but such cases are not, in my experience, common, and in them the clinical picture usually leaves little doubt regarding the diagnosis.

A high degree of eosinophilia is always suggestive, though it may occur in other helminthic infestations; eosinophilia, as pointed out by Bruns, Liefmann, and Mickel, is not to be regarded as of equal value to a microscopical examination of the faeces.

Stool examinations for ova are rendered much more certain following a vermifuge, and the use of Clayton Lane's flotation concentration method renders diagnosis much more accurate.

Beri-beri is sometimes confounded with ankylostomiasis, but the former is a disease of great rarity in 'Iraq; the paretic and cardiac symptoms of the former disease, too, are in excess of those accountable for by the degree of anaemia present.

In 'Iraq, of all diseases, malaria most commonly simulates ankylostomiasis, but the splenomegaly, periodic fever, and the blood picture, usually make the differential diagnosis a relatively simple matter, though one must always be prepared to find the two conditions co-existing. In malaria, too, the loss of haemoglobin is proportional to the destruction of red blood corpuscles while in ankylostomiasis it is distinctly greater.

I have known chronic nephritis occasionally to present difficulty in differential diagnosis, but examination of the urine usually suffices to distinguish the two conditions; the blood pressure, too, in ankylostomiasis is low.



## PROGNOSIS.

Except in severe cases the prognosis is usually good, though modified by the recuperative powers of the patient, and the presence or absence of intercurrent disease.

The degree of eosinophilia is a valuable guide to prognosis, as it represents the degree of resistance to the poison of the helminth; in very severe cases little or no eosinophilia is present, and a rise in eosinophilia is generally to be noted in cases that are making good progress.

## TREATMENT.

In my experience there are two drugs of outstanding merit in this condition, namely, oil of chenopodium, and thymol.

I have tried also beta naphthal, male fern, chloroform, and eucalyptus, but with nothing like the same measure of success. Thymol is not nearly as efficient an anthelmintic as oil of chenopodium, and, too, I have found it more liable to produce toxic effects.

Beyond occasional dizziness, I have observed no ill-effects from the use of pure oil of chenopodium; I am convinced that most of the toxic results obtained by some other observers must have been due to an impure oil, containing deleterious ingredients.

The anthelmintic action of the oil depends on the presence of an active principle, ascaridole.

I have tried the administration of oil of chenopodium in varying doses, but have found the method advocated by Darling of giving the oil in three doses of 8 minims, each at hourly intervals, the most

satisfactory. I commence with two days semi-starvation, and an hour after the last dose administer one ounce of magnesium sulphate.

Darling advocates the use of capsules, and in private practice they are preferable; in my hospital cases I have found a freshly prepared emulsion equally satisfactory, and, being less costly, this is a very important advantage in its employment in 'Iraq.

The dose of thymol in this connection is 30 grains, in capsules, at 2 hourly intervals - two doses in all, and followed by magnesium sulphate, has been my practice, and it has worked well, though, as I have already stated, I have not found it nearly as efficient as oil of chenopodium.

Iron and arsenic are usually required to overcome the anaemia in moderate and severe cases, but should only be given after expulsion of the helminths.

More recently the use of carbon tetrachloride as a vermifuge has been advocated by a number of observers, and striking results have been reported from its use. Its toxic effects appear to be negligible when a pure preparation is employed, and its cheapness suggests it as a suitable drug for mass treatment should its efficacy be later confirmed.

#### PROPHYLAXIS.

The prophylaxis is similar to that described for schistosomiasis, though there is no snail host in the life history of *Ankylostoma duodenale*. Prevention of snail and water pollution by excrement are the essential points in prophylaxis, and the keynote is abundant and

and accessible latrine accommodation.

The river-side defaecation of the native population makes the peril of increased spread of the disease in 'Iraq a very real one and my more recent observations point to the fact that the incidence is undoubtedly increasing.

I agree with Looss that drinking water is not as a rule dangerous, as larvae sink to the bottom in standing water and are only brought to the top by shaking.

#### 4. INFESTATION WITH *NECATOR AMERICANUS*.

I have only met with two cases of this infestation during my service in 'Iraq, once in Hillah, and once in Baghdad. One of these, however, was most probably an imported case. Both cases occurred in adult arabs, one a resident of Abadan, in the Persian Gulf, and the other a resident of Najaf, both of whom were on a visit to Baghdad. In each case, in addition to the ova found in the stools, adult specimens of both male and female worms were obtained following the administration of oil of chenopodium.

The eggs of *Necator americanus* are slightly larger than those of *Ankylostoma duodenale*, but they cannot be differentiated with certainty.

The adult worms of *Necator americanus* are more slender, and are shorter than those of *Ankylostoma duodenale*, and the worms are further readily distinguishable by differences in their buccal capsules and the caudal bursae of the males.

The buccal capsule of *Necator americanus* is smaller and has an irregular border; in place of the

four sharp teeth of *Ankylostoma duodenale*, *Necator americanus* has a ventral pair of cutting plates, and the dorsal teeth are represented by a slightly developed pair of chitinous plates.

The main difference in the caudal bursae are that the dorsal ray of *Necator americanus* branches at its base into divergent rays with bipartite tips, instead of tridigitate as in *Ankylostoma duodenale*.

The Najaf case represents, as far as I know, the only case of infestation with *Necator americanus* on record in 'Iraq, and the locality of the infestation is, I think, strongly suggestive that it was brought to the town by pilgrims visiting the shrines of the city.

In neither case was the infestation a very severe one; the Najaf case displayed 3 months' old mild dyspeptic symptoms, and his blood count an eosinophilia of 5%.

The Abadan case was admitted to the New General Hospital, Baghdad, on 2.1.23 with slight ascites, and complaining of having experienced persistent pain in the epigastrium for 6 months previously. Dyspepsia, anaemia, and other signs and symptoms suggestive of infestation were, however, absent. Both patients were successfully treated by Oil of *Chenopodium*.

Prophylaxis is as for *Ankylostoma duodenale*.

##### 5. INFESTATION WITH *STRONGYLOIDES STERCORALIS*.

Conditions suitable for the spread of ankylostomiasis are equally suitable to the spread of *Strongyloides stercoralis*; it is not surprising, therefore, to find evidence of infestation with the latter parasite in



stool examinations of cases living in districts where the former is prevalent.

In no instance have I found ova of the parasite in stools. Stool examination in positive cases has invariably shown the larval form of the helminth, and in fresh stools as a rapidly moving snake-like organism in the field of the microscope, in size of 0.2 mm. to 0.3 mm. in length, with rounded head, double bulbed oesophagus, and pointed tail. In 520 stool examinations, in Hillah, I found the parasite on 5 occasions, and, in all but one of the cases, ova of *Ankylostoma duodenale* were also present.

2 of the cases occurred in children, and 3 in adults, and all of the five cases were Mohammedan males, from country districts, as follows :-

Hillah neighbourhood	..	3
Diwanayah	..	1
Kerbala	..	1

The case which was unassociated with ankylostomiasis was the Kerbala case. He complained of dyspeptic symptoms, and was intensely anaemic, but, being also heavily infected with malaria, the relative importance of the infestation was difficult to assign. In my series of 164 stool examinations of Baghdad residents, in 1922-1923, I did not on any occasion meet with this parasite.

Prophylaxis is the same as that for *Ankylostoma duodenale*.

## 6. INFESTATION WITH TRICHURIS TRICHIURA.

This cosmopolitan parasite is very prevalent throughout 'Iraq, and my figures give an incidence of 111 positive results in 520 stool examinations in Hillah, during 1919-1920, a percentage of 21.3%, and, in 1922-1923, in 164 examinations of stools of residents in Baghdad, I obtained positive findings in 27 cases; a percentage of 16%. I have commonly noted the presence of Charcot Leyden crystals in the stools of patients infested with *Trichuris trichiura* in 'Iraq.

Beyond the slightly greater incidence of this infestation in the rural population as compared with the towns, there is no discernible difference in the incidence of infestation throughout the country.

The higher incidence in rural districts is, I think, readily explainable in exactly the same way as is infestation with ascariasis, namely, cruder sanitation, and cruder personal hygiene.

The majority of one's cases have been symptomless; that *Trichuris trichiura* does at times adopt a pathogenic rôle, however, is, I think, certain.

During the winter of 1922-1923, in the New General Hospital, Baghdad, I had seven cases of *Trichuris trichiura* in whom intestinal symptoms were present. These cases were almost identical in their symptoms, which were attacks of intestinal colic associated with chronic diarrhoea; frequently, mucus was present, and in three of the cases there was slight tinging of the stools with blood.

Careful clinical, microscopical, and cultural

examination, in these cases revealed no pathology beyond the presence of numbers of the ova of the parasite, and, in 3 cases, one of *Ascaris lumbricoides* in addition. Treatment proved difficult as anthelmintics were not eminently successful, but with the expulsion of numbers of the parasites <sup>by</sup> weekly doses of oil of chenopodium their symptoms steadily lessened.

In two cases, too, in which as far as possible other conditions were excluded, and *Trichuris trichiura* ova were present in large numbers, cerebral symptoms presented themselves.

In both these cases there were present low continued fever, headache, and nervous irritability, and, in one case, - I saw the cases in consultation with a local doctor - diagnosis of typhoid fever and meningitis, respectively, had been made. A stool examination was made, as is my custom in all such obscure cases. Both cases were in Jewish boys, aged about 10 years, and the exhibition of thymol in 5 grain doses on alternate days, for 3 doses, in each case resulted in loss of all signs and symptoms.

As with ascariasis, so with trichuriasis; both sexes, and all ages, except infants, are infested. The highest incidence in 'Iraq is in children about 8 to 10 years of age.

Prophylaxis is similar to that described for *Ascaris lumbricoides*.

*Trichuris trichiura* has great powers of resistance; the eggs develop outside the body in moist surroundings, and infested hands may transfer ova to food.

The ova are swallowed and infestation thus occurs.

Patients may possibly re-infest themselves as no intermediate host is needed; in this way a vicious circle of infestation may be set up.



## SECTION XI.

### MULTIPLE INFESTATIONS IN 'IRAQ.

In the sections in which individual infestations have been considered I have not included multiple infestations, preferring to collect my figures together into a separate section devoted to this subject.

I have divided my figures for this purpose under two headings, (a) rural population, and (b) urban population.

Of the series of 520 stool examinations conducted in Hillah, 463 of them were fellaheen, and these figures will be quoted as representing the rural population of the country (Table VI on next page).

The remaining 57 Hillah examinations, all residents of Hillah, added to the series of 164 Baghdad examinations, a total of 221, are quoted as representing the urban population of 'Iraq (Table VII).

Further, the stools of the 56 positive cases of schistosomiasis observed in Hillah were examined for the presence of helminthic ova, and the results of these examinations are shown in Table VIII.

The urines of all the cases positive to intestinal helminths were examined for ova of *Schistosoma haematobium*, and the figures for the rural and urban

## MULTIPLE INFESTATIONS.

## INTESTINAL HELMINTHS.

Rural Population (463 persons).

TABLE VI.

Helminth.	total infestations.	Taenia saginata	Ascaris lumbricoides	Ankylostoma duodenale	Enterobius vermicularis	Strongyloides stercoralis	Trichuris trichiura.
Taenia saginata	12	4	4	1	0	0	3
Ascaris lumbricoides	81	4	28	16	4	0	29
Ankylostoma duodenale	73	1	16	32	2	4	18
Enterobius vermicularis	24	0	4	2	16	0	2
Strongyloides stercoralis	5	0	0	4	0	1	0
Trichuris trichiura	98	3	29	18	2	0	46
Total infestations.	293						

The infestations shown in the above table represent 196 persons. The percentage of the rural population infested with intestinal parasites is therefore 42.3, and the degree of infestation 1.49 parasites to each person infested.

Addendum.

MULTIPLE INFESTATIONS

RURAL POPULATION.

Of the 196 persons represented in Table VI 69 displayed multiple infestations, a percentage of 35.2%.

The average rural incidence of schistosomiasis is 47.8% (Hillah district, p.63).

The percentage of schistosomiasis cases associated with intestinal helminths is 57.1% (Table VIII).

The percentage of infested persons with multiple infestations is, therefore,  $(35.2 + \frac{47.8 \times 57.1}{100}) = 62.5\%$

## MULTIPLE INFESTATIONS.

## INTESTINAL HELMINTHS.

Urban Population (221 persons).

TABLE VII.

Helminth	Total infestations.	Taenia saginata	Ascaris lumbricoides	Ankylostoma duodenale	Enterobius vermicularis	Strongyloides stercoralis	Trichuris trichiura
Taenia saginata	10	6	1	0	1	0	2
Ascaris lumbricoides	36	1	20	5	0	0	11
Ankylostoma duodenale.	10	0	5	3	0	0	2
Enterobius vermicularis	6	1	0	0	5	0	0
Strongyloides stercoralis	0	0	0	0	0	0	0
Trichuris trichiura	40	2	11	2	0	0	25
Total infestations.	102						

The infestations in the above table represent 76 persons. The percentage of the urban population infested with intestinal parasites is therefore 34.4, and the degree of infestation 1.34 parasites to each person infested.



Addendum.

MULTIPLE INFESTATIONS.

URBAN POPULATION.

Of the 76 persons represented in Table VII,  
17 displayed multiple infestations, a percentage of  
22.3%.

The average urban incidence of schistosomiasis is  
22.3%. (Hillah town, p. 63).

The percentage of schistosomiasis cases associated  
with intestinal helminths is 57.1%. (Table VIII.).

The percentage of infested persons with multiple  
infestations is, therefore,  $(22.3 + \frac{22.3 \times 57.1}{100}) = 35.0\%$ .

populations are considered separately in Tables IX & X.

Infestations with *Fasciola hepatica*, *Clonorchis sinensis*, *Hymenolepis nana*, *Taenia echinococcus*, *Taenia solium*, *Dipylidium caninum*, and *Necator americanus*, are not included in the tables, as infestations with them were not found in the course of a special series of routine stool examinations.

Table VI shows the incidence of persons infested with intestinal parasites among the rural population to be 42.3% and the degree of infestation 1.49 parasites to each person infested.

Table VII shows the incidence of persons infested with intestinal parasites among the urban population to be 34.4%, and the degree of infestation 1.34 parasites to each person infested.

The higher incidence observed among the rural population is in keeping with the higher incidence of helminthic infestations in general observed in them.

Table VIII represents a series of 56 positive cases of infestation with *Schistosoma haematobium* in which 32 cases (57.1%) were also infested with other parasites.

Table IX shows the association of intestinal helminthic infestations with *Schistosoma haematobium* among the rural population. It strikingly demonstrates the common association of infestations of *Schistosoma haematobium* with *Ankylostoma duodenale*, and further reveals a total helminthic incidence in the rural population of 62.3%.

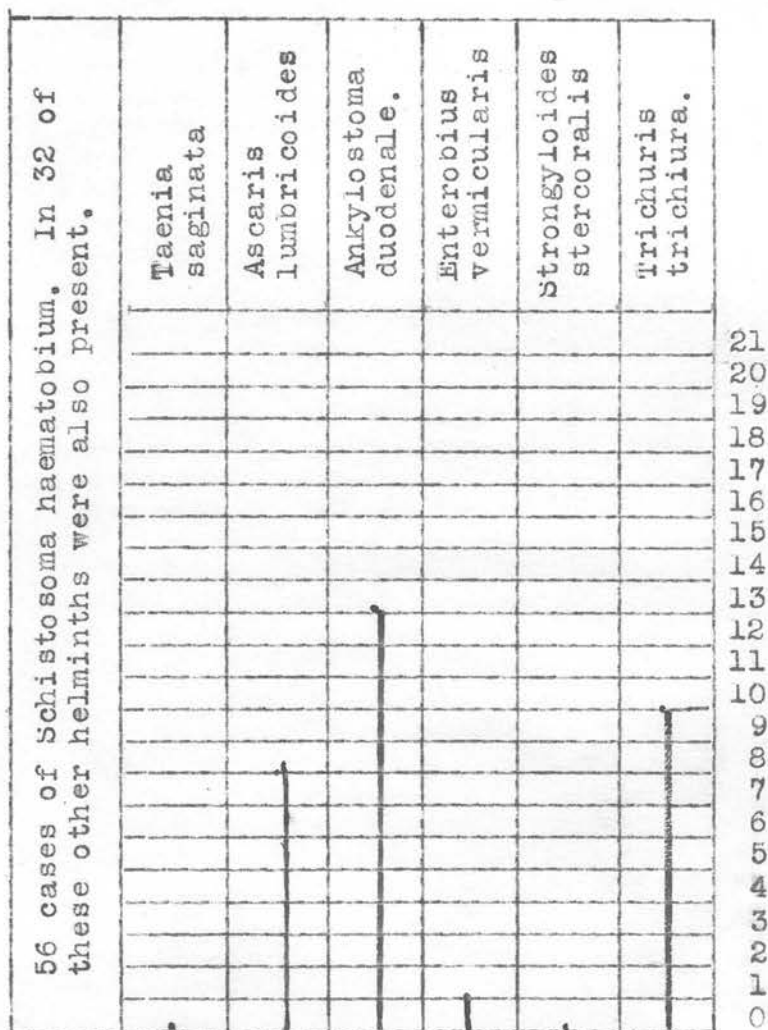
Table X <sup>similarly</sup> refers to the urban population and reveals a total helminthic incidence in the urban population of 45.0%.

## MULTIPLE INFESTATIONS.

TABLE VIII.

*Schistosoma haematobium* in association  
with other helminths.

A series of 56 cases of infestation with  
*Schistosoma haematobium* in the Hillah District; 32  
(57.1%) of these with multiple infestations.



The rural population only has been chosen for this series as the urban population shows ~~very~~ little infestation with *Schistosoma haematobium*.

## MULTIPLE INFESTATIONS.

TABLE IX.

Rural population (Hillah District)  
 Intestinal helminthic infestations (293 cases)  
 in association with *Schistosoma haematobium*.  
 (57 positive findings).

Helminths	No. infested also with <i>Schistosoma</i> <i>haematobium</i>	Percentage
<i>Taenia</i> <i>saginata</i> (12 cases)	2	16.6
<i>Ascaris</i> <i>lumbricoides</i> (81 cases)	13	16.0
<i>Ankylostoma</i> <i>duodenale</i> (73 cases)	23	31.5
<i>Enterobius</i> <i>vermicularis</i> (24 cases)	2	8.3
<i>Strongyloides</i> <i>stercoralis</i> (5 cases)	Nil	-
<i>Trichuris</i> <i>trichiura</i> (98 cases)	17	17.3
Total	57	19.5

The 293 cases represent 196 persons (Table VI).  
 Percentage of rural population infested with  
 intestinal parasites (Table VI) = 42.3%  
 Rural incidence of infestation with *Schistosoma*  
*haematobium* (Hillah district) = 47.8%  
 Percentage of cases of Schistosomiasis associated  
 with intestinal helminths (Table VIII) = 57.1%  
 Percentage of cases of Schistosomiasis  
 unassociated with intestinal helminths = 42.9%  
 Percentage of rural population infested with  
 helminths =  $(42.3 + \frac{47.8 \times 42.9}{100}) = 62.8\%$



## MULTIPLE INFESTATIONS.

TABLE X.

Urban Population (Baghdad &amp; Hillah).

Intestinal helminthic infestations (102 cases).

in association with *Schistosoma haematobium*

(13 positive findings).

Helminth	No. infested also with <i>Schistosoma</i> <i>haematobium</i>	Percentage
<i>Taenia saginata</i> (10 cases)	Nil	-
<i>Ascaris lumbricoides</i> (36 cases)	4	11.1
<i>Ankylostoma duodenale</i> . (10 cases)	2	20.0
<i>Enterobius vermicularis</i> ( 6 cases)	1	16.6
<i>Strongyloides stercoralis</i> (Nil)	Nil	-
<i>Trichuris trichiura</i> (40 cases)	6	15.0
Total	13	12.7

The 102 cases represent 76 persons (Table VI).

Percentage of urban population infested with intestinal parasites (Table VI) = 34.4%.

Urban incidence of infestation with *Schistosoma haematobium* (Hillah town) = 22.3%.

Percentage of cases of schistosomiasis associated with intestinal helminths (Table VIII) = 57.1%.

Percentage of cases of schistosomiasis unassociated with intestinal helminths = 42.9%.

Percentage of urban population infested with helminths =  $(34.4 + \frac{22.3 \times 42.9}{100}) = 45.0\%$ .



MULTIPLE INFESTATIONS.

Two cases of schistosomiasis and ankylostomiasis  
from the Euphrates district south of Hillah.

Corr. to P.C. AA. S. 24.

. 9(4201-05)

Holinshed (Raphael).

The first and second volumes of chronicles,  
comprising 1. The description and historie  
of England. 2. The description and  
historie of Ireland. 3. The description and  
historie of Scotland: first collected and  
published by R.H., William Harrison  
and others, now ... continued by

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The figures in these tables reveal the very common association of four helminths, namely, *Ascaris lumbricoides*, *Trichuris trichiura*, *Ankylostoma duodenale*, and *Schistosoma haematobium*, and, in approximately 10% of my multiple infestations, all four parasites have been present.

Slightly over 25% of my multiple infestations have shown the presence of 3 parasites; it has been from the four parasites just mentioned that the majority of these trios have been supplied; an unusual combination which I observed once was the presence of *Taenia echinococcus* with *Ascaris lumbricoides* and *Schistosoma haematobium*.

The remaining 65% of multiple infestations have been dual ones.

The frequency with which multiple infestations occur emphasises the importance of always being on the look-out for such an association.

In the majority of instances, the added infestation of one intestinal parasite with another produces no peculiar signs or symptoms; the only really serious common combination is *Ankylostoma duodenale* and *Schistosoma haematobium*, and, unfortunately for Iraq, they are a common multiple infestation, as the figures in the tables show.

From the figures given the number of species of parasites present is demonstrated; in the rural population there are 1.49 species of intestinal helminths to each person infested, and, in the urban population 1.34. The inclusion of the figures for schistosomiasis give

the total helminthic incidence per infested person, and these are, respectively, 1.78 and 1.51.

Hillah district being situated between the zones of highest and lowest infestation, the figures given supply, I think, a very fair indication of helminthic infestation among the rural population, and, similarly, those of Baghdad and Hillah town together may be accepted as representative of the incidence among town dwellers in 'Iraq.



## SECTION XII.

### S U M M A R Y.

The observations contained in this thesis represent the first written survey of the helminthic infestations of man in 'Iraq.

Such infestations, due to favourable conditions of spread, are extremely common, and especially so among the rural population.

The parasitic helminths of 'Iraq are 14 in number, namely:-

(a) TREMATODES :

1. *Fasciola hepatica*
2. *Clonorchis sinensis*.
3. *Schistosoma haematobium*.

(b) CESTODES :

4. *Hymenolepis nana*.
5. *Taenia saginata*.
6. *Taenia solium*.
7. *Taenia echinococcus*.
8. *Dipylidium caninum*.

(c) NEMATODES :

9. *Ascaris lumbricoides*.
10. *Ankylostoma duodenale*.
11. *Necator americanus*.
12. *Enterobius vermicularis*
13. *Strongyloides stercoralis*
14. *Trichuris trichiura*.

The figures contained in my thesis indicate that from the age of 8 or 9 years upwards some 63% of the

rural population harbour helminthic parasites of some kind or other.

The figures for the urban population show a lower general incidence, and more especially so with regard to infestations with *Ankylostoma duodenale* and *Schistosoma haematobium*. My figures indicate an urban incidence of helminthic infestation of 45.0%

The lower incidence of infestation in the towns is accounted for by the better hygienic and sanitary conditions which prevail there, especially with regard to disposal of excreta and control of water supply.

Ankylostomiasis and schistosomiasis are very prevalent, and the crippling effects of these two infestations on the population make them, from both a medical and economic point of view, the two most important infestations which exist in the country.

There are a number of factors which control helminthic spread in Iraq, and, of these, the most important are the warm climate, the lack of control of water supply, the presence of intermediate hosts, and the poor sanitary conditions prevailing as a result of ignorance and poverty.

Other factors, such as immigration and the association of the inhabitants with domestic animals, too, present problems of no little importance.

*Fasciola hepatica* is very rarely parasitic in man, and I have only noted one case to date; in sheep, however, infestation with this parasite is common.

*Clonorchis sinensis*, too, I have only observed once in the country; this was an imported infestation from India.

Infestation with *Schistosoma haematobium*, known by the arab as "harrij bol", is very common, more especially on the lower Euphrates.

Schistosomiasis shows its highest incidence between Diwaniyah and Qurnah.

Qurnah is the traditional site of the Garden of Eden, and here the Tigris and Euphrates join to form the wide Shatt-al-Arab; the incidence in this swampy neighbourhood reaches as high as 80% of the population.

Town dwellers show a much lower incidence than the fellaheen, and this is accounted for by the better sanitary conditions of the towns, and the non-agricultural pursuits of the majority of the inhabitants.

In this thesis I have been able to correct a number of published mis-statements relating to schistosomiasis in the country, both regarding its distribution and also the forms of infestation prevalent. I am able to state definitely that *Schistosoma mansoni* is not represented in the helminthic fauna of 'Iraq, and, in view of the fact that only a few doubtful specimens of *Planorbis boissyi* have been discovered, there seems no reason to anticipate its appearance.

*Bullinus contortus* I have observed to be very local in its distribution, and this I attribute to the varying degrees of salinity in the soil.

In the course of my observations, a totally new

manifestation of infestation with *Schistosoma haematobium* has been noted, namely, the formation of rectal papillomata. For this reason I suggest that the present nomenclature of the three known varieties of schistosomiasis, namely, "urinary schistosomiasis", "intestinal schistosomiasis", and "schistosomiasis of the Far East" should be discontinued in favour of schistosomiasis with the name of the helminth following, thus :-

- (a) Schistosomiasis (*S. haematobium*).
- (b) Schistosomiasis (*S. mansoni*).
- (c) Schistosomiasis (*S. japonicum*).

An important factor in snail spread in 'Iraq is that the annual flooding of the countryside synchronises with the period of snail breeding; in this way young molluscs are spread over wide areas of country.

As a whole 'Iraq is not as heavily infested as Egypt, a situation readily explained by the fact that the population is only 20% as dense as that of the latter country; infestation has not the same facilities for spread in a sparsely populated community.

My observations suggest that only about 20% of the fellaheen infested with *Schistosoma haematobium* present symptoms.

*Hymenolepis nana* I have noted on 5 occasions. The smallness and transparency of the ova of this parasite make them difficult to discover on microscopical examination, and hence I should not be surprised if the true incidence of this infestation were somewhat higher than my figures indicate.

*Taenia saginata* is a prevalent parasite, its

incidence varying from under 3% in the rural population, to ~~almost~~ 5% among town dwellers. The higher incidence in the urban population I consider to be due to the fact that more meat is eaten in the towns than among the more frugal fellaheen.

*Taenia solium* is only very rarely met with; the domestic pig is not existent in 'Iraq, and the animal is unclean to the Mohammedans and Jews who constitute 90% of the population.

Infestation with *Taenia echinococcus* is widespread in distribution, but is not nearly as prevalent as the association between man and dog existing in the country might suggest.

*Ascaris lumbricoides* is a very common infestation, and my figures indicate a general incidence among the native population of about one infestation in every six persons. Ascariasis is the commonest variety of helminthiasis among Europeans in 'Iraq. Among children this infestation not uncommonly simulates typhoid fever, and the frequency with which it co-exists with goitre in young adult females suggests a possible association of this infestation with a thyroid lesion in 'Iraq.

With regard to *Enterobius vermicularis*, my routine stool examinations indicate a general incidence of 4% for the population of 'Iraq, the incidence among the rural population, as with the other helminths, being higher than that of the town dwellers.

I observed that ova of *Enterobius vermicularis* are found in the stools in only about one infestation



in every six, so that my figures probably require multiplication to indicate the true incidence of infestation with this parasite.

Infestation with *Ankylostoma duodenale*, as with *Schistosoma haematobium*, is essentially a disease of the fellahs, and my figures suggest an average incidence of 15% among them; in the areas of high infestation, geographically the same as with schistosomiasis, the incidence in all probability reaches 60% or even more.

The frequency with which I have found ankylostomiasis associated with atrophic cirrhosis of the liver is, I think, of peculiar interest as the latter condition is very prevalent in 'Iraq, and alcohol in the majority of cases can be definitely excluded as a factor. My observations suggest a special liability to infestation with *Ankylostoma duodenale* in cases already infested with *Schistosoma haematobium*.

A point in diagnosis of ankylostomiasis in 'Iraq is the almost invariable presence of cautery scars in the region of the epigastrium in all but very mild cases.

*Necator americanus* is a rarity in the country at present; I have noted only two cases to date.

Conditions being so favourable for the spread of this helminth, however, pilgrim traffic may in time result in this infestation becoming much commoner.

Infestation with *Strongyloides stercoralis* is also uncommon. I have noted it apart from ankylostomiasis in one case only, out of a total of 5 infesta-

tions with this parasite.

*Trichuris trichiurs* is a very common parasite in 'Iraq, but it does not commonly cause symptoms; my figures indicate a general percentage incidence of about 20%.

Multiple infestations are extremely common, the most crippling combination being ankylostomiasis and schistosomiasis.

Among the rural population my series show that 62.5% of infested persons have multiple infestations, and in the urban population 35.0%, and that the number of species of worm harboured by each infested person are 1.78, and 1.51, for the rural and urban population, respectively.

Helminthic infestations are responsible for much sickness and ill-health in 'Iraq, and apart from their importance from a medical point of view, there is a further serious aspect to be considered, namely, the economic one.

'Iraq is a country of great future promise, in agriculture especially. The population is small, and the standard of health is low. Helminthic infestations play a large share in this existing state of affairs by the mortality and crippling effects which they manifest.

If 'Iraq is to prosper, the standard of health of her population must be raised, and the rate of mortality lessened; this certainly cannot be accomplished until a campaign against helminthiasis is waged, and then only can the fight be successful through the

concerted efforts of the Departments of Irrigation,  
Education, and Health.



Colour contrast in helminthiasis.

Two ankylostomiasis cases standing on either side of a case of schistosomiasis and demonstrating the greater degree of pallor in the former infestation.

### SECTION XIII.

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